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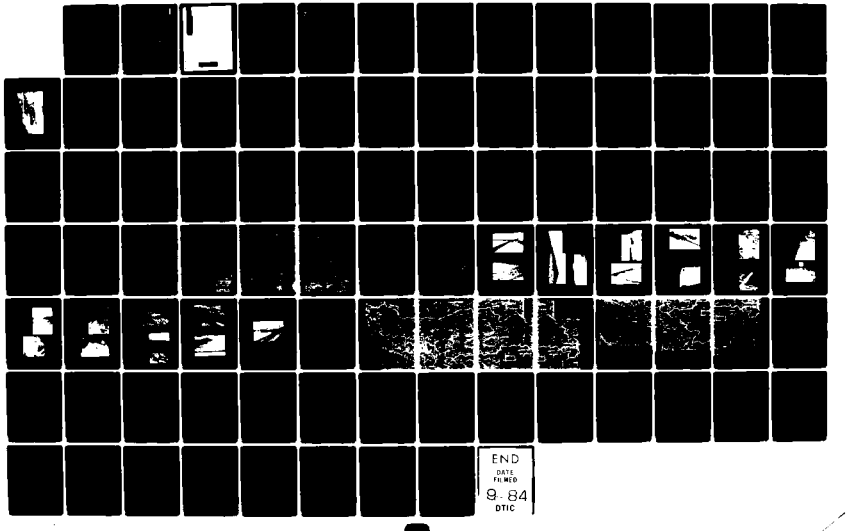

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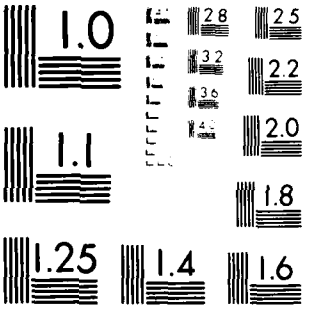

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Housatonic River Basin
Warren, Connecticut

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Upper Shepaug Reservoir Dam is a 1,000 foot long earth embankment dam, and has a maximum height of 87 feet. Top width of the dam is 20 feet and appurtenant structures include a side channel spillway, spillway channel and an outlet works. The visual inspection indicated that the dam is in good condition. Based on its intermediate size and high hazard classification the test flood is equal to the PMF.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

SEP 24 1979

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

I am forwarding to you a copy of the Upper Shepaug Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, City of Waterbury, 236 Grand Street, Waterbury, Connecticut 06702.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely yours,

Max B. Scheider

Incl
As stated

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

UPPER SHEPAUG RESERVOIR DAM

CT 00634

HOUSATONIC RIVER BASIN
WARREN, CONNECTICUT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I - INSPECTION REPORT
BRIEF ASSESSMENT

Identification No.: CT 00634

Name of Dam: Upper Shepaug Reservoir Dam

Town: Warren

County and State: Litchfield, Connecticut

Stream: West Branch of the Shepaug River

Date of Inspection: December 6, 1978

Upper Shepaug Reservoir Dam is a 1,000 foot long earth embankment dam, and has a maximum height of 87 feet. Top width of the dam is 20 feet and appurtenant structures include a side channel spillway, spillway channel and an outlet works.

Engineering data available consisted of a set of plans dated January, 1963 showing plan, section and details of the dam. No construction specifications or design calculations were available.

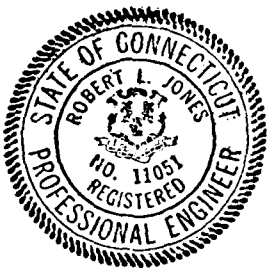
The visual inspection of Upper Shepaug Reservoir Dam indicated that the dam is in good condition. The inspection revealed some minor problems including holes up to 3 feet in diameter in the earth berm downstream of the embankment near the left (east) abutment. Riprap indicates sloughing has occurred on the right (west) slope of the outlet channel, small trees were observed in the right (west) wall and floor of the spillway discharge channel. Loose blocks of rock were evident in the spillway channel, standing water was observed on two berms of the downstream slope that is believed to be melt water. A slight bulge up to 1 foot above normal surface was observed on the downstream slope. The dam does not appear to be in jeopardy. Visual inspection also confirmed a well established maintenance program.

Based on its intermediate size and high hazard classification in accordance with the Corps guidelines the test flood is equal to the Probable Maximum Flood. The spillway will pass the test flood outflow of 11,900 cfs with a pool elevation of 920.1 feet which is 1.9 feet below the top of the dam.

Based on the findings of the visual inspection and hydrologic and hydraulic analysis, there is no need for further engineering studies or for major alterations to the dam. Provisions should be made by the owner to repair the existing holes in the berm downstream of the embankment

and sloughing riprap on the right (west)side of the spillway discharge channel and remove the trees and loose blocks of rock in the spillway discharge channel.

The recommendations and remedial measures are described in Section 7 and should be addressed within two years after receipt of this Phase I - Inspection Report by the owner.



Robert L. Jones, P.E.
Project Manager

Philip W. Genovese & Associates, Inc.
Hamden, Connecticut

This Phase I Inspection Report on **Upper Shepaug Reservoir Dam** has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division

CARNEY M. TERZIAN, CHAIRMAN
Chief, Structural Section
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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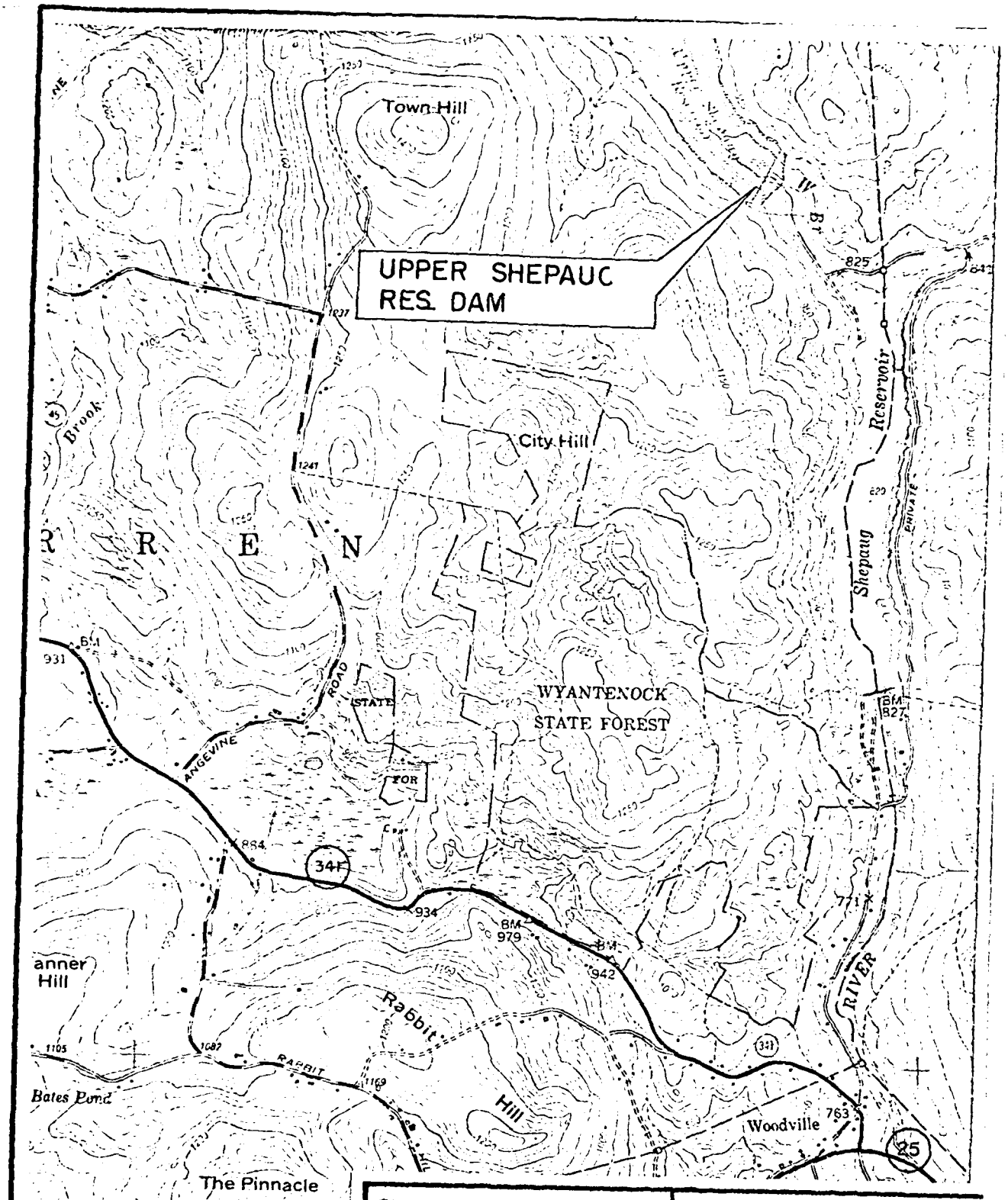


PHILIP W. GENOVESE AND ASSOCIATES, INC.
ENGINEERS–HAMDEN, CT.

U.S. ARMY ENGINEER DIV.
NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS
LOCATION MAP

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Philip W. Genovese and Associates, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Philip W. Genovese and Associates, Inc. under a letter of November 28, 1978 from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACW33-79-C0019 has been assigned by the Corps of Engineers for this work.

b. Purpose.

(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Upper Shepaug Reservoir Dam is located on the West Branch of the Shepaug River in the Town of Warren, Connecticut, approximately 2.5 miles north of Woodville. The dam is approximately 0.3 of a mile upstream from Shepaug Reservoir which is an impoundment of both the East and West Branch of the Shepaug River. The dam is shown on U.S.G.S. Quadrangle, New Preston, Connecticut with coordinates approximately N41°44.6', W 73°18', Litchfield County, Connecticut. The location of the dam is shown on the Location Map immediately preceding this page.

b. Description of Dam and Appurtenances. Upper Shepaug Reservoir Dam consists of an earth embankment section and a concrete spillway. The embankment section of the dam is approximately 1,000 feet in length. The spillway section has a total length of about 100 feet and is located to the right of the embankment.

Maximum structural height, according to existing plans, is 87 feet for the earth embankment section.

The existing plans indicate that the intake tower of the dam is founded on bedrock.

Appurtenant structures consist of a side channel concrete spillway, spillway channel and an outlet works structure. The spillway consists of a 100 foot long concrete section at crest elevation of 910 feet. The spillway channel is bounded by concrete retaining walls.

The outlet works consist of a diversion inlet, an intake tower and gate chamber containing 7 gates with two intake pipes and a diversion outlet. Two 30" x 36" sluice gates allow water to enter the intake chamber from two 42" intake pipes at elevation 847.3 feet. Two 48" x 72" sluice gates control flow through the 96" conduit at elevation 833.7 feet to the chamber. The discharge gates to the diverion outlet from the chamber are of elevation 838.0 feet and the drain valve is at elevation 833.5 feet. The sketch in Appendix D shows details of the outlet works.

Figure 1, located in Appendix B, shows the plan of the dam and its appurtenant structures. Photographs of each structure are shown in Appendix C.

c. Size Classification. Intermediate (hydraulic height- 87 feet high, storage 14742 acre-feet) based on storage ($\geq$ 1,000 to 50,000 acre-feet) as given in Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. The dam's potential for damage rates it as a high hazard classification. A major breach would result in discharge into Shepaug Reservoir about 1500 feet downstream. Shepaug Reservoir is approximately 6000 feet long. Downstream of the Shepaug Dam about 6000 feet is Woodville which has 12 to 15 houses with 3 low and close to the Shepaug River. There is no habitation downstream of Upper Shepaug Dam to a point downstream of Shepaug Dam.

e. Ownership. The dam is owned by the City of Waterbury, 236 Grand Street, Waterbury, Connecticut.

f. Operator. This dam is maintained and operated by the City of Waterbury, Connecticut, Bureau of Water. The superintendent of Reservoirs is Mr. Leonard J. Assard, phone (203) 283-9139.

g. Purpose of Dam. This dam is used for water supply for the City of Waterbury.

h. Design and Construction History. Based on State of Connecticut files, the dam was constructed between 1964 and 1965. The "construction permit" is dated December 11, 1964 and the "certificate of approval" is dated December 21, 1965.

i. Normal Operating Procedure. No data was disclosed for maintenance of reservoir water levels. Under normal operation, two 30 inch x 36 inch sluice gates transmit water from intake pipes to the intake tower. From the gate chamber, two 24 inch fixed cone valves discharge downstream to the diversion outlet. Water then flows down the stream channel to the Shepaug Reservoir.

1.3 Pertinent Data

a. Drainage Area. The drainage area tributary to Upper Shepaug Reservoir consists of approximately 10.4 square miles of mountainous and rolling terrain. In addition to the reservoir, 10 percent of the basin is made up of lake and swamp area. There is no significant development in the drainage area. Elevations in the basin range from about 850 feet to 1,500 feet MSL.

The reservoir consists of about 348 acres at the normal (top of spillway) pool elevation. No dwellings are located along the reservoir shores.

b. Discharge at Dam Site .

(1) The outlet works for the reservoir consists of two 30 inch by 36 inch intake sluice gates at elevation 847.3 feet and two 48 inch x 72 inch intake sluice gates at elevation 833.7 feet. Water is discharged by two 24 inch fixed cone valves at ℄ elevation 838.0 feet. A four inch drain valve is located at elevation 833.5 feet. Water is discharged downstream through an 8 foot diameter diversion outlet pipe. The pipe outlets at elevation 831.5 to a concrete wing wall outlet section. From the outlet section water flows into the stream bed and then to the Shepaug Reservoir approximately 1500 feet downstream.

(2) There are no records of maximum discharge at the dam site, however, in June, 1977, a depth of flow of 0.75 feet was measured

at the crest of the spillway. This would give a discharge of approximately 300 cfs.

(3) The spillway capacity with a water surface at the top of dam (elevation 922) would be approximately 18,200 cfs.

(4) The spillway capacity with the water surface at the test flood elevation of 920.1 feet is approximately 11,900 cfs.

(5) The total project discharge at the test flood elevation of 920.1 feet is 11,900 cfs.

c. Elevation (feet above MSL).

(1) Streambed at centerline of dam - 835

(2) Maximum tailwater - N/A

(3) Upstream portal invert diversion tunnel - 832.75

(4) Recreation pool - N/A

(5) Full flood control pool - N/A

(6) Spillway crest (permanent spillway) 910

(7) Design surcharge - unknown

(8) Top dam - 922

(9) Test flood surcharge - 920.1

d. Reservoir (miles).

(1) Length of maximum pool - 2.2

(2) Length of recreational pool - N/A

(3) Length of flood control pool - N/A

e. Gross Storage (acre-feet).

(1) Recreation pool - N/A

(2) Flood control pool - N/A

(3) Spillway crest pool - 10,090

(4) Top of dam - 14,740

(5) Test flood pool - 13,942

f. Reservoir Surface (acres).

(1) Recreation pool - N/A

(2) Flood control pool - N/A

(3) Spillway crest - 348

(4) Test flood pool - 420

(5) Top dam - 430

g. Dam.

(1) Type - Earthen

(2) Length - 1,000 feet

(3) Height - 87 feet (maximum)

(4) Top width - 20 feet

(5) Side slopes - Upstream: 1:2.75 - Downstream 1:2.25 w/berms.

(6) Zoning - None

(7) Impervious core - None

(8) Cutoff - None

(9) Grout curtain - Construction plans indicate the following:"weak and shattered rock: to fill seams in rock and any space between rock and masonry work". Grout holes "shall be drilled at the locations ordered."

(10) Other - Unknown

h. Diversion and Regulating Tunnel. See Section j below.

i. Spillway.

(1) Type - Ogee shaped side channel overflow weir.

(2) Length of weir - 100 feet

(3) Crest elevation - 910 feet

(4) Gates - None

(5) Upstream channel - Class "A" concrete and bedrock. Rectangular with Class "A" concrete walls from 5 feet upstream of crest elevation 915 feet.

(6) Downstream channel - Class "A" concrete rectangular channel 20 feet wide from spillway to 161 feet downstream. Walls are vertical and variable in height. From end of concrete section channel is bedrock, 20 feet wide and variable in height with 3 feet minimum.

j. Regulating Outlets. The reservoir can be drained by a 96 inch outlet pipe set at approximately elevation 838. This pipe is controlled by two 24 inch valves located in the gate chamber building. The four water supply intakes feed the intake tower, gate chamber and diversion outlet. The intakes and outlets are controlled separately by valves located in the intake tower and gate chamber.

SECTION 2
ENGINEERING DATA

2.1 Design

This dam was constructed in 1964 and 1965 for water supply purposes. A set of plans dated 12/58 as prepared by Malcolm Pirnie Engineers showing plan, elevation, typical sections and details is available at the Office of the Engineer, City Hall, Waterbury, Connecticut. No in-depth engineering data were found for this dam.

2.2 Construction

No construction records were avaiable for use in evaluating the dam other than a set of plans marked "As-Built".

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

a. Availability. Other than the set of plans described above, no additional engineering data was found to be available.

b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgement.

c. Validity. The field investigation indicated that the external features of Upper Shepaug Reservoir Dam substantially agree with those on the available plans.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of the Upper Shepaug Reservoir Dam was made on December 6, 1978. The inspection team consisted of personnel from Philip W. Genovese & Associates, Inc. and Geotechnical Engineers, Inc. Representatives of the City of Waterbury, Bureau of Water were also present during portions of the inspection. Inspection checklists, completed during the visual inspection are included in Appendix A. At the time of the inspection, the water level was approximately 21.5 feet below the permanent spillway elevation. No water was passing over the spillway. The upstream face of the dam could only be inspected above this water level.

b. Dam. The dam consists of an earthen embankment section about 1000 feet long. The crest is at elevation 922 according to the design drawings.

According to the design drawings, the intake tower gate chamber and spillway are founded on bedrock. The appearance of bedrock outcrops at several locations downstream and adjacent to the spillway is consistent with the design drawings in this respect.

The embankment is covered with grass and appears to be in good condition. The upstream slope is covered with riprap from the toe to an elevation 7 feet above the flow line.

Occasional holes up to 3 feet in diameter occur in an earth berm downstream of the embankment near the left (east) abutment as can be seen in Photos 18, 19 and 20. Informed sources reported the use of rock and boulder fill in the area which suggests that holes are the result of soil collapsing into voids between rock fill. Small bulges and slight depressions on the downstream slope were observed and attributed to differential settlements or minor sloughing. The most pronounced bulge , extending to one foot above the normal slope surface was found approximately 150 feet right (west) of the control tower between the intermediate and lower berm.

Water was observed flowing into the two collection manholes at the downstream toe of the slope.

There is limited information in the available design drawings as to whether the embankment section is founded on bedrock or not. The plans indicate the intake chamber control tower and the spillway are located on bedrock.

No seepage was observed at the downstream slope or downstream toe of the embankment.

c. Appurtenant Structures. Visual inspection of the concrete spillway, spillway channel, and outlet works did not reveal any evidence of stability problems. The concrete surface and construction joints appeared to be in good condition with the exception of occasional cracks and seepage in the spillway discharge channel as seen in Photo 9.

The spillway structure, shown in Photos 6, 7, 9, 10, and 12 consists of an ogee shaped, side channel concrete weir 100 feet long with concrete training walls. The concrete spillway surface is in good condition.

The outlet works consists of a diversion inlet, an intake tower and gate chamber and a diversion outlet that discharges to the stream channel. As the intake structure was below water, it was not inspected. Of the gates located in the gate chamber, four control inlet and two control outlet. Two intakes are at elevation 833.7 feet and two are at 847.3 feet. Two outlets are at elevation 838 feet. All gates are reported to be functional. The discharge conduit is located at elevation 831.5 feet. As all gates were below water in the gate chamber,they could not be inspected. However, all parts of the gate chamber that could be inspected appeared to be in good condition.

The spillway discharge channel is in good condition with the exception of occasional cracks and seeps as shown in Photo 9.

d. Reservoir Area. The reservoir area has mountainous to rolling terrain, partially wood covered. A more detailed description of the drainage area is included in Section 1.3 of this report. There was no development observed along the shoreline.

e. Downstream Channel. The spillway discharge channel and the outlet works meet in the stream bed approximately 900 feet downstream of the spillway at approximately elevation 830 feet. The spillway channel is paved for a distance of approximately 270 feet downstream of the spillway as seen in Photo 6. The remainder of the downstream spillway channel is excavated in bedrock as shown in Photo 10. The diversion outlet discharges from the gate chamber through a 96 inch reinforced concrete pipe into a 10 foot wide open channel at elevation 831.5 feet. Minor sloughing of riprap was observed in the right (west) wall of the outlet channel downstream of the diversion outlet.

Occasional loose rocks were observed on the bottom of the spillway discharge channel. A few 2 to 3 inch diameter trees are growing from the right (west) wall of the spillway discharge channel. An 8

inch diameter tree growing from the channel floor was observed near the intersection with the diversion outlet channel as shown in Photo 10. Also minor seepage was observed at joints in the bedrock wall on the right (west) side of the spillway discharge channel.

3.2 Evaluation

Visual examination indicates that the dam is in good condition. No seepage was observed from the foundation or abutments of the embankment sections of the dam. The inspection revealed the following:

a. Occasional holes in the earth berm adjacent to the embankment.

b. Small bulges and depressions on the downstream face of the embankment.

c. Cracks and seepage in the concrete spillway discharge channel.

d. Minor sloughing of riprap in the outlet channel of the diversion outlet.

e. Occasional rocks and trees in the spillway discharge channel.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedure

Upper Shepaug Reservoir Dam creates an impoundment which is used primarily as a water supply for the City of Waterbury. The normal operational procedure is to draw water from the reservoir and pipe it downstream to the stream bed which flows into Shepaug Reservoir. Water is also discharged through the spillway channel to the Shepaug Reservoir.

4.2 Maintenance of Dam

This dam is visited on a frequent basis by personnel of the City of Waterbury, Bureau of Water. These visits are primarily for surveillance of the reservoir for water quality control purposes. General maintenance is accomplished during these visits.

4.3 Maintenance of Operating Facilities

Maintenance on the operating facilities is done on a regular basis.

4.4 Description of Warning Systems

There are no warning systems in effect at this facility.

4.5 Evaluation

The current operating and maintenance procedures for the dam are to insure that all problems encountered can be remedied within a reasonable period of time. The owner should establish a written operation and maintenance procedure as well as establishing a warning system to follow in event of flood flow conditions or imminent dam failure.

SECTION 5
HYDROLOGY AND HYDRAULIC ANALYSIS

5.1 Evaluation of Features

Upper Shepaug Reservoir Dam is a 1,000 foot long earthen embankment with a 100 foot long concrete spillway. The maximum structural height of the dam is 87 feet. Appurtenant structures other than the spillway consist of a spillway channel and an outlet works. The spillway crest is at elevation 910 feet. The outlet works consist of a diversion inlet, an intake tower and gate chamber and a diversion outlet. The diversion inlet is controlled by two 30 inch x 36 inch and two 48 inch x 72 inch sluice gates and the diversion outlet is controlled by two 24 inch cone valves. The large intake gates are at elevation 833.7 feet and the small gates are at elevation 847.3 feet. Outlets are at elevation 838 feet ℄. Upper Shepaug Reservoir Dam is classified as Intermediate in size having a maximum storage of 14,740 acre-feet.

a. Design Data. No hydrologic or hydraulic design data were disclosed for this dam.

b. Experience Data. The maximum discharge at this dam site is unknown. The maximum observed condition was reported to be nine inches over the spillway or about 300 cfs.

c. Visual Observations. No evidence of damage to any portion of the project from overtopping was visible at the time of the inspection.

d. Test Flood Analysis. As no detailed design and operational information are available, hydrologic evaluation was performed using dam information gathered by field inspection, watershed size and an estimated test flood equal to the Probable Maximum Flood (PMF) as determined by guide curves issued by the Corps of Engineers. Based on a drainage area of 10.4 square miles, it was estimated that the test flood flow at this dam would be 18,720 cfs. Following the guidance for Estimating Effect of Surcharge Storage on Maximum Probable Discharges results in a test flood discharge of 11,900 cfs. As the maximum spillway capacity at the top of the dam is 18,212 cfs, the spillway will pass the PMF without over topping the dam.

e. Dam Failure Analysis. The impact of failure of the dam at maximum pool (top of dam) was not assessed using the "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers.

A downstream routing was not accomplished as there is only about 1,500 feet of uninhabited valley that lies between Upper Shepaug Dam and the upstream reaches of Shepaug Reservoir, both important water supply facilities for the Waterbury area. Shepaug Dam was breached and downstream water profile to Woodville was established.

Relative storage capabilities of Upper Shepaug and Shepaug Reservoir Dams are:

	Upper Shepaug	Shepaug
Storage to Spillway Crest (Ac-Ft.)	N/A	2,000
Storage to top of dam (Ac-Ft.)	14,700	3,000

An analysis using a breaching outflow of 237,600 cfs and utilizing the discharge rating curve and data for Shepaug Reservoir Dam, the surcharge would be 33.5 feet above the spillway crest of Shepaug Dam.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The visual examination did not disclose any immediate stability problems. Routine maintenance should be sufficient to prevent any long-term problems.

b. Design and Construction Data. Design drawings are available for the dam. They include general information regarding the overall dimensions of the dam and appurentenances. This information is not sufficient to assess the stability of the dam and it must be judged primarily from visual observations. Grouting of the bedrock was required by the contract documents but the details are not available.

c. Operating Records. No operating records pertinent to the structural stability of the dam were available.

d. Post Construction Changes. Since original construction in 1964 and 1965 no significant changes or additions have been made at the site.

e. Seismic Stability. The dam is located in Seismic Zone 1, and in accordance with recommended Phase I guidelines does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual examination indicates that the dam is in good condition. The inspection revealed:

(1) Occasional holes up to 3 feet in diameter in the earth berm adjacent to the downstream side of the embankment near the left (east) abutment.

(2) Small bulges and slight depressions on the downstream face of the embankment. The most pronounced bulge about 1 foot above the normal slope was found about 150' right (west) of the control tower.

(3) Cracks and seepage in the concrete spillway discharge channel.

(4) Minor sloughing of riprap in the right (west) wall of the outlet channel downstream of the diversion outlet.

(5) Occasional rocks and trees in the bedrock portion of the spillway discharge channel.

b. Adequacy of Information. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgement.

c. Urgency. This dam is in good condition and no recommendations are required. The remedial measures described in Section 7.3 should be accomplished within two years after receipt of this Phase I Inspection Report by the owner.

d. Need for Additional Investigation. The findings of this inspection indicate that there is no need for additional investigations.

7.2 Recommendations

Based on the findings of the visual inspection and hydrologic and hydraulic analysis there is no need for further engineering studies or for major alterations to the dam.

7.3 Remedial Measures

(a) Existing holes in the downstream berm near the left (east) abutment should be backfilled and appropriate cover planted. If and when new holes appear, they should be routinely examined and backfilled.

(b) Sloughing riprap on the right (west) slope of the outlet channel should be repaired.

(c) Small trees in the right (west) wall and the 8 inch diameter tree in the floor of the spillway discharge channel should be removed. Also, all loose blocks of rock in the channel floor should be removed.

(d) Establish an operational procedure and formal warning system to follow for emergency conditions.

(e) Develope a biennial technical inspection program.

7.4 Alternatives

There is no practical alternative to the recommendations in Sections 7.2 and 7.3.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT: UPPER SHEPAUG DAM (Cairns)

DATE: December 6, 1978

TIME: 1300

Crest of dam 922.0

Spillway Crest 910.0

WEATHER: Sunny- 40°-50°

W.S. ELEV. 888.55 U.S. DN.S.

PARTY:

1. Bob Jones	Party Chief	
2. Don Ballou	Hydraulics/Hydrology	
3. Karl Dalenberg	Geotechnical	
4. Dick Murdock	"	
5. Leonard Assard	Owner's Rep.	

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECKLIST

PROJECT: UPPER SHEPAUG DAM DATE: December 6, 1978

PROJECT FEATURE: Earthen Dam Embankment NAME

DISCIPLINE NAME

	AREA EVALUATED	CONDITION
	DAM EMBANKMENT	
)B	Crest Elevation	922.0' USGS
)B	Current Pool Elevation	888.55' USGS
BJ	Maximum Impoundment to Date	910.75' ± USGS
EI	Surface Cracks	None
EI	Pavement Condition	Gravel roadway
GEI	Movement or Settlement of Crest	None observed
EI	Lateral Movement	None observed
EI	Vertical Alignment	Good
GEI	Horizontal Alignment	Good
EI	Condition at Abutment and at Concrete Structures	Slight surface erosion at gatehouse
EI	Indications of Movement of Structural Items on Slopes	None
EI	Trespassing on Slopes	None
EI BJ	Sloughing or Erosion of Slopes or Abutments	Minor surface slough 375' left (east) of spillway on downstream slope near 2nd berm
EI	Rock Slope Protection-Riprap Failures	Good, random blocks, no failures
EI	Unusual Movement or Cracking at or Near Toe	None
EI	Unusual Embankment or Downstream Seepage	None
EI	Piping or Boils	None

PERIODIC INSPECTION CHECKLIST

PROJECT: UPPERSHEPAUG DAM DATE: December 6, 1978

PROJECT FEATURE: Earthen Dam Embankment NAME _____

DISCIPLINE _____ NAME _____

	AREA EVALUATED	CONDITION
	DAM EMBANKMENT - Continued	
GEI	Foundation Drainage Features	Slight flow out of toe drains into manholes at downstream toe.
GEI	Toe Drains	Water elevation in right manhole is 4'9" below top of manhole & in left manhole 10'6" below top
GEI	Instrumentation System	None
GEI	Vegetation	Well maintained grass slopes

PERIODIC INSPECTION CHECKLIST

PROJECT UPPER SHEPAUG DAM DATE: December 6, 1978

PROJECT FEATURE Other Embankment NAME

DISCIPLINE NAME

	AREA EVALUATED	CONDITION
	DIKE EMBANKMENT	
BJ	Crest Elevation	None
	Current Pool Elevation	
	Maximum Impoundment to Date	
;EI	Surface Cracks	
GEI	Pavement Condition	
;EI	Movement or Settlement of Crest	
;EI	Lateral Movement	
GEI	Vertical Alignment	
;EI	Horizontal Alignment	
GEI	Condition at Abutment and at Concrete Structures	
GEI	Indications of Movement of Structural Items on Slopes	
;EI	Trespassing on Slopes	
GEI	Sloughing or Erosion of Slopes or Abutments	
GEI	Rock Slope Protection-Riprap Failures	
;EI	Unusual Movement or Cracking at or Near Toes	
;EI	Unusual Embankment or Downstream Seepage	
·EI	Piping or Boils	
GEI	Foundation Drainage Features	
·EI	Toe Drains	
GEI	Instrumentation System	
·EI	Vegetation	

PERIODIC INSPECTION CHECKLIST

PROJECT UPPER SHEPAUG DAM DATE: December 6, 1978

PROJECT FEATURE: Outlet Works- Intake NAME

DISCIPLINE NAME

	AREA EVALUATED	CONDITION
	OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
	a. Approach Channel	Under water, not observed
EI	Slope Conditions	
GEI	Bottom Conditions	
GEI	Rock Slides or Falls	
	Log Boom	
	Debris	
	Condition of Concrete Lining	
EI	Drains or Weep Holes	
	b. Intake Structure	
	Condition of Concrete	
	Stop Logs and Slots	

PERIODIC INSPECTION CHECKLIST

PROJECT: UPPER SHEPAUG DAM DATE December 6, 1978

PROJECT FEATURE Outlet Works - Tower NAME

DISCIPLINE NAME

	AREA EVALUATED	CONDITION
	OUTLET WORKS - CONTROL TOWER	
	a. Concrete and Structural	
J	General Condition	Good
BJ	Condition of Joints	Good
⌐J	Spalling	None
J	Visible Reinforcing	None
BJ	Rusting or Staining of Concrete	None
⌐J	Any Seepage or Efflorescence	None
·J	Joint Alignment	Good
BJ	Unusual Seepage or Leaks in Gate Chamber	None
BJ	Cracks	None
·J	Rusting or Corrosion of Steel	None
	b. Mechanical and Electrical	
	Air Vents	Gates and operating mechanisms are located in control tower. Control mechanisms are in good condition. Gates not accessible for inspection.
	Float Wells	
	Crane Hoist	
	Elevator	
	Hydraulic System	
	Service Gates	
	Emergency Gates	
	Lighting Protection System	
	Emergency Power System	
	Wiring and Lighting System	

PERIODIC INSPECTION CHECKLIST

PROJECT: UPPER SHEPAUG DAM DATE December 6, 1978

PROJECT FEATURE Outlet Works NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	N/A
General Condition of Concrete	
Rust of Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSPECTION CHECKLIST

PROJECT: UPPER SHEPAUG DAM DATE December 6, 1978

PROJECT FEATURE Outlet Works - Channel NAME

DISCIPLINE NAME

	AREA EVALUATED	CONDITION
	OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
BJ	General Condition of Concrete	Fair
BJ	Rust or Staining	Some
BJ	Spalling	Some
	Erosion or Cavitation	
BJ	Visible Reinforcing	Some
BJ	Any Seepage or Efflorescence	Some seepage through cracks
BJ	Condition at Joints	Fair to poor
GEI	Drain holes	None
GEI	Channel	Sloped riprap sides, good condition
GEI	Loose Rock or Trees Overhanging Channel	None
GEI	Condition of Discharge Channel	Good

PERIODIC INSPECTION CHECKLIST

PROJECT: UPPER SHEPAUG DAM DATE December 6, 1978

PROJECT FEATURE Outlet Works - Spillway NAME

DISCIPLINE NAME

	AREA EVALUATED	CONDITION
	OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
	a. Approach Channel	
GEI	General Condition	Good
GEI	Loose Rock Overhanging Channel	None
GEI	Trees Overhanging Channel	None
GEI	Floor of Approach Channel	Sand & gravel floor, good condition
	b. Weir and Training Walls	
GJ	General Condition of Concrete	Good
GJ	Rust or Staining	Some
BJ	Spalling	None
BJ	Any Visible Reinforcing	None
	Any Seepage or Efflorescence	On abutment side slight seepage through joints and cracks of concrete wall.
EI	Drain Holes	Many on abutment side, some seeping
	c. Discharge Channel	
EI	General Condition	Good
GEI	Loose Rock Overhanging Channel	None observed
GEI	Trees Overhanging Channel	None observed
EI	Floor of Channel	Concrete floor adjacent to embankment in bedrock surface ending in loose rock at downstream end.
GEI	Other Obstructions	One 6"-8" tree in center of spillway at downstream end.

PERIODIC INSPECTION CHECKLIST

PROJECT: UPPER SHEPAUG DATE December 6, 1978

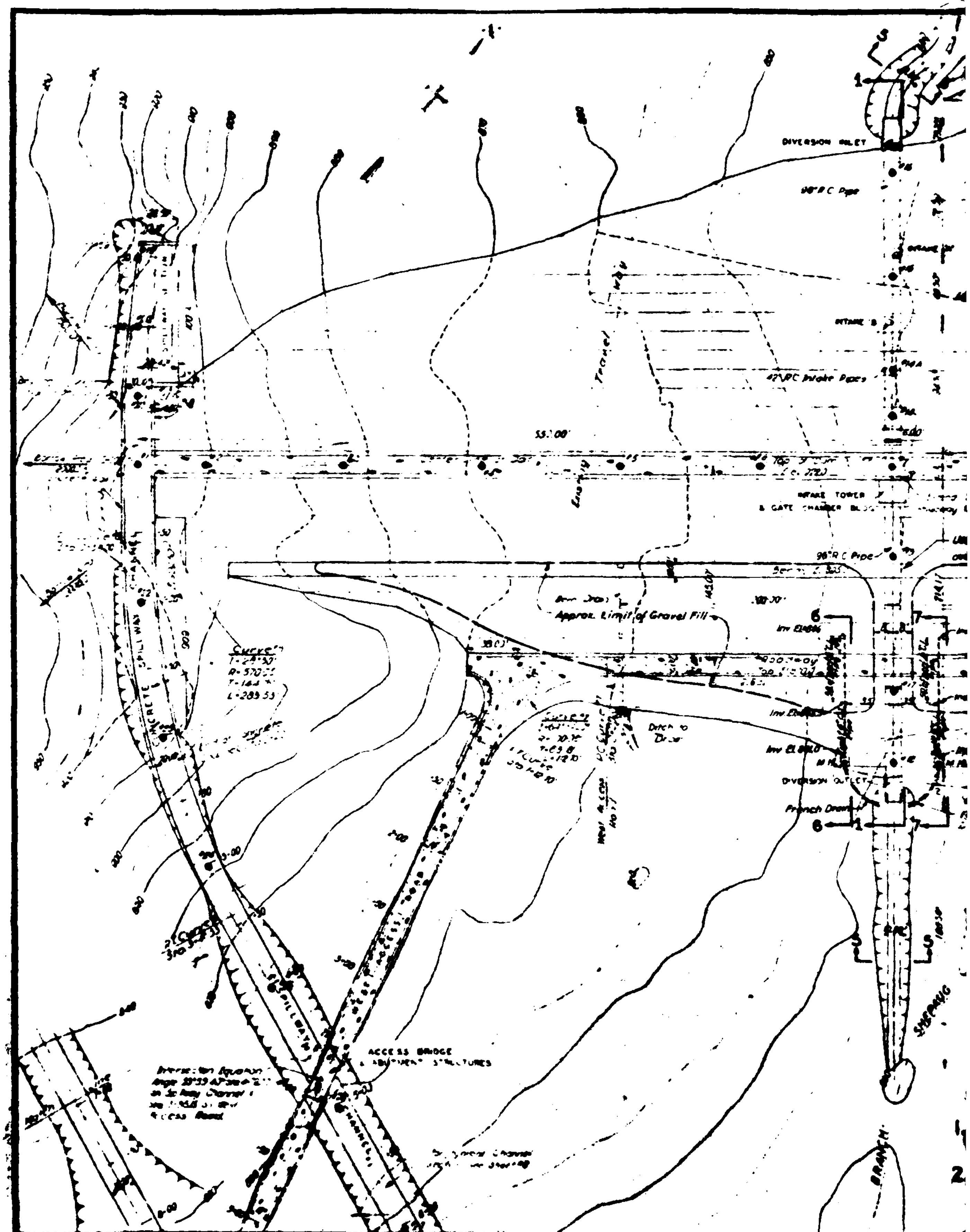
PROJECT FEATURE Outlet Works NAME

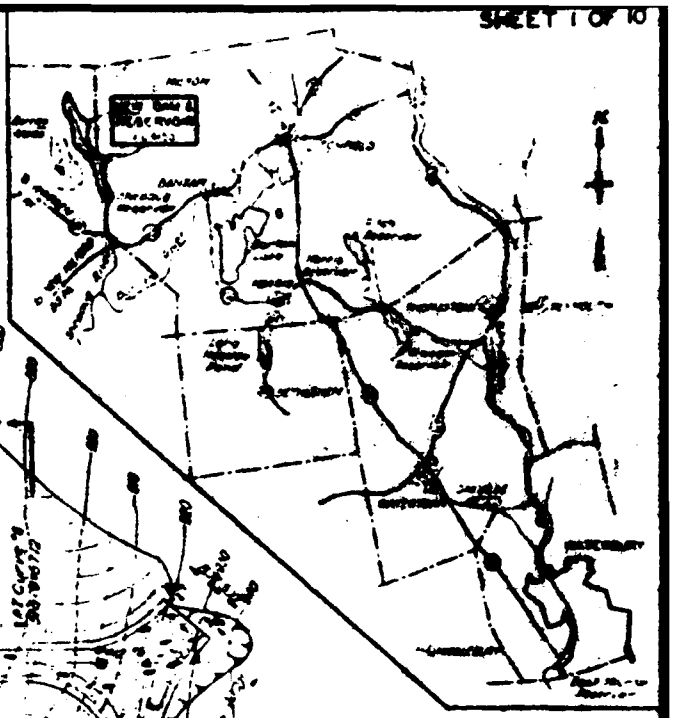
DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	
a. Super Structure	None
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Underside of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat and Backwall	

APPENDIX B

ENGINEERING DATA

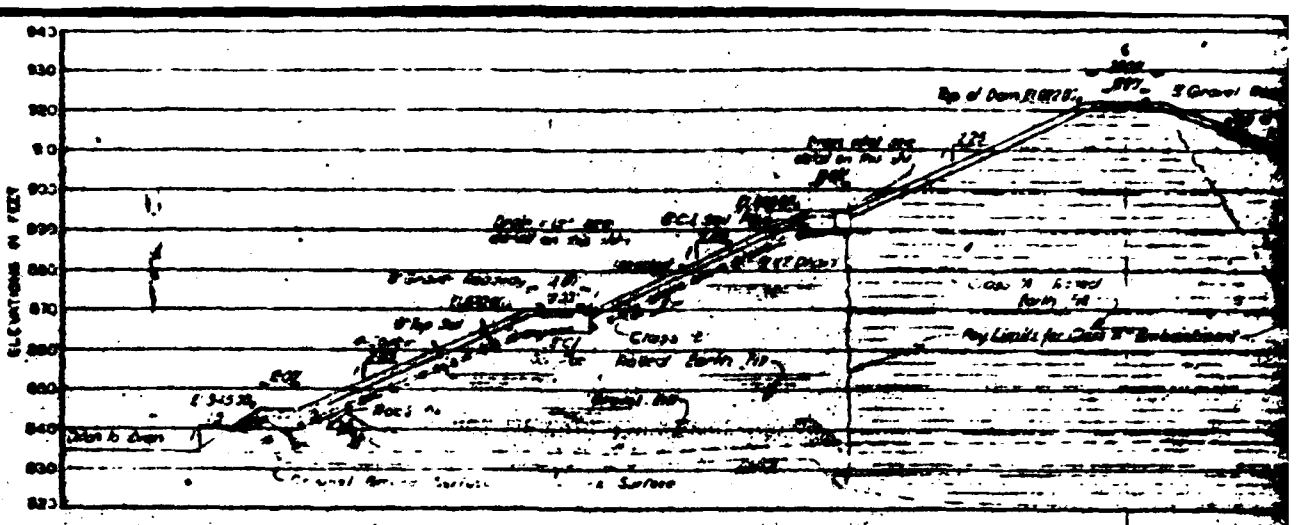

DIVERSION INLET
98" R.C. Pipe
42" RC Intake Pipes
Tunnel
INTAKE TOWER
& GATE CHAMBER BLOCK
98" R.C. Pipe
Approx. Limit of Gravel Fill
DIVERSION OUTLET
French Drain
ACCESS BRIDGE
ABUTMENT STRUCTURES
BRANCH



LOCATION PLAN
SCALE

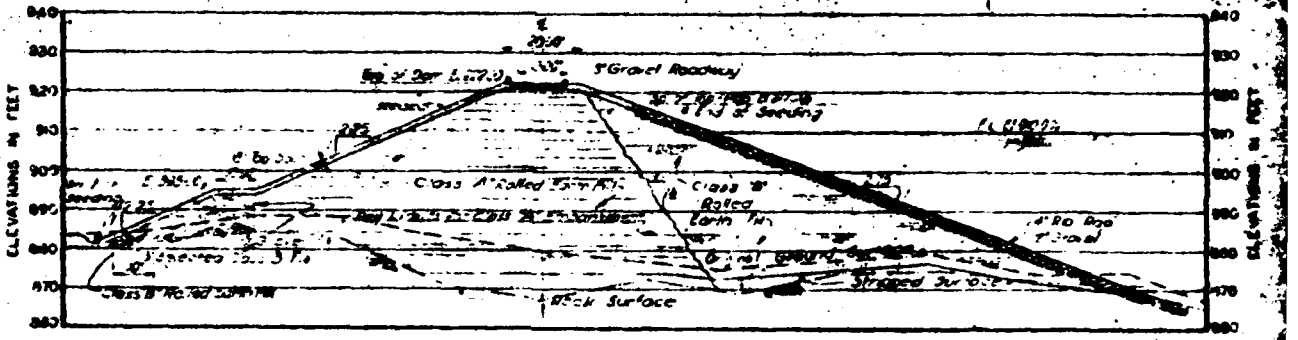
NOTES:
1. "AS BUILT" DRAWING OBTAINED FROM OWNER
2. DATUM IS M.S.L.

UPPER SHEPAUG
RESERVOIR DAM



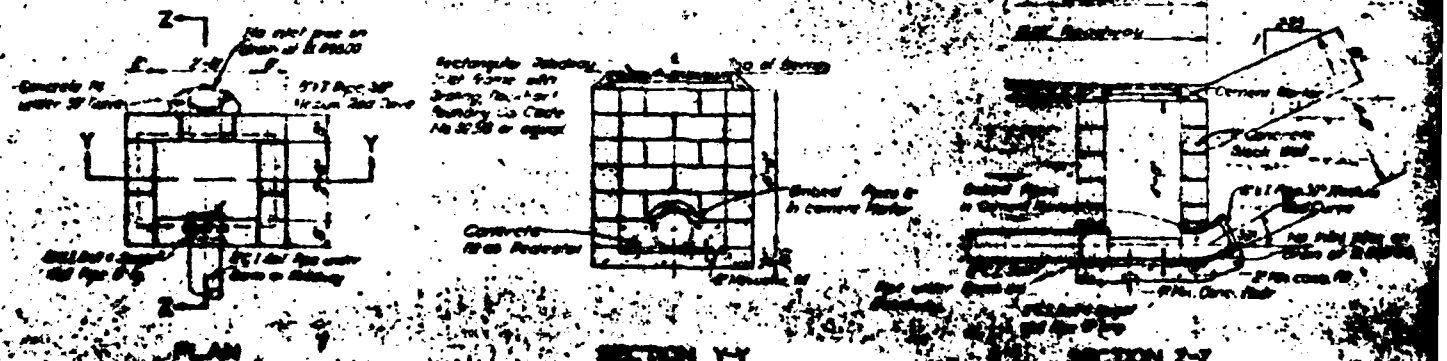
MAX. DAM SECTION 2-2

SCALES: HORIZ. 1"=20'
VERT. 1"=20'



DAM SECTION 3-3 STATION 10+75

SCALES: HORIZ. 1"=20'
VERT. 1"=20'



PLAN

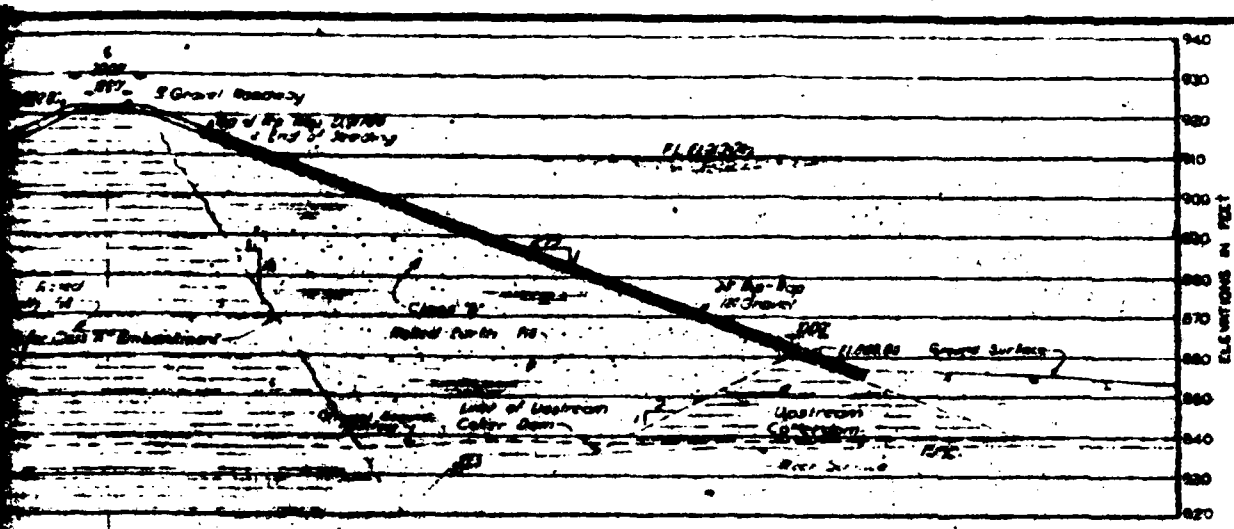
SECTION Y-Y

SECTION Z-Z

BERM DRAIN INLET DETAIL

SCALE 1/4"=1'-0"

HEADLEY-WHITE ENGINEERS
660 Park Ave., New York, N. Y.

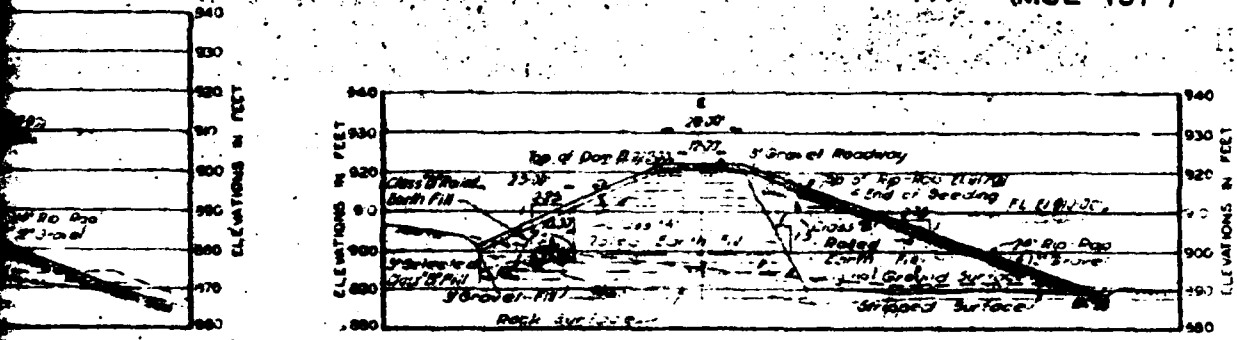


DAM SECTION 2-2

SCALES: HORIZ. 1"=20'
VERT. 1"=20'

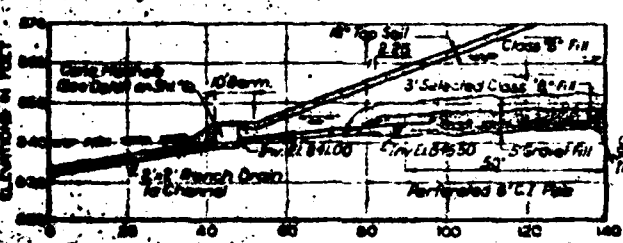
NOTES:

1. "AS BUILT" DRAWING OBTAINED FROM OWNER
2. DATUM IS WATERBURY DATUM (MSL-137')



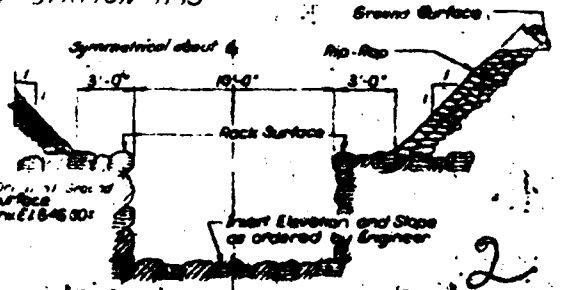
DAM SECTION 4-4 STATION 11+15

SCALES: HORIZ. 1"=20'
VERT. 1"=20'



SECTION 6-6

SCALES: HORIZ. 1"=20'
VERT. 1"=20'



SECTION 5-5

SCALE: 1/8"=1'-0"

SECTION 7-7

"AS BUILT"

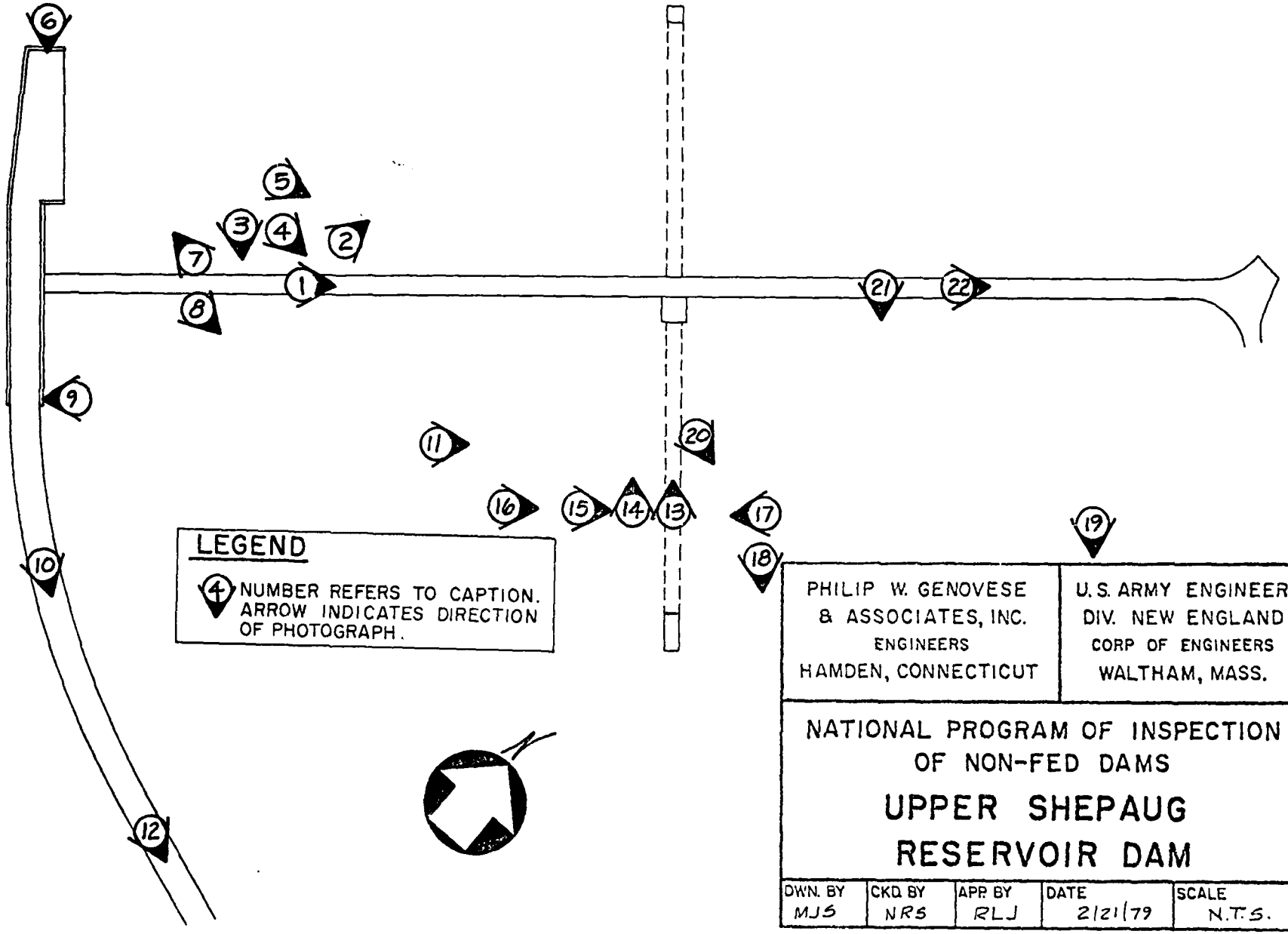
PHILIP H. GERVERSE & ASSOCIATES, INC. ENGINEERS HAMDEN, CONNECTICUT	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

UPPER SHEPAUG RESERVOIR DAM

APPENDIX C

PHOTOGRAPHS



LEGEND

4 NUMBER REFERS TO CAPTION. ARROW INDICATES DIRECTION OF PHOTOGRAPH.

PHILIP W. GENOVESE & ASSOCIATES, INC. ENGINEERS HAMDEN, CONNECTICUT	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORP OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

UPPER SHEPAUG RESERVOIR DAM

DWN. BY	CKD. BY	APP. BY	DATE	SCALE
MJS	NRS	RLJ	2/21/79	N.T.S.

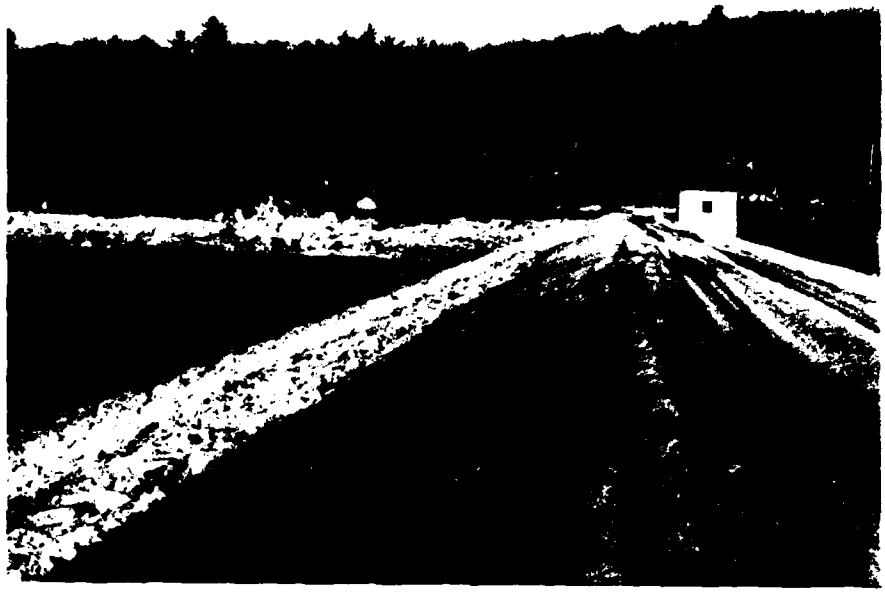


PHOTO NO. 1 - Looking along upstream face toward east abutment, 150' left (east) of spillway channel.

PHOTO NO. 2 - Looking upstream at riprap, 150' left (east) of spillway channel.

PHOTOS NO. 3, 4 and 5 - Panorama of three shots from right (west) side toward left (east) abutment. Showing upstream face of dam. Note upstream spillway training wall in extreme right.

PHOTO NO. 6 - Spillway channel looking downstream from right (north) training wall of side channel spillway.

PHOTO NO. 7 - Looking toward side channel spillway approach channel from 100 feet left (east) of spillway channel.

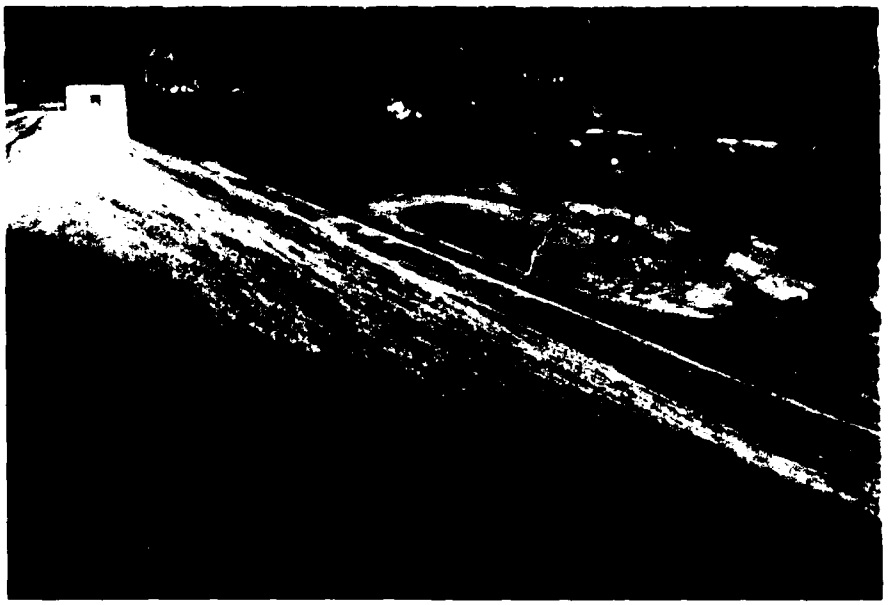


PHOTO NO. 8 - Looking along downstream face toward left (east) abutment from crest 100' left (east) of spillway channel.

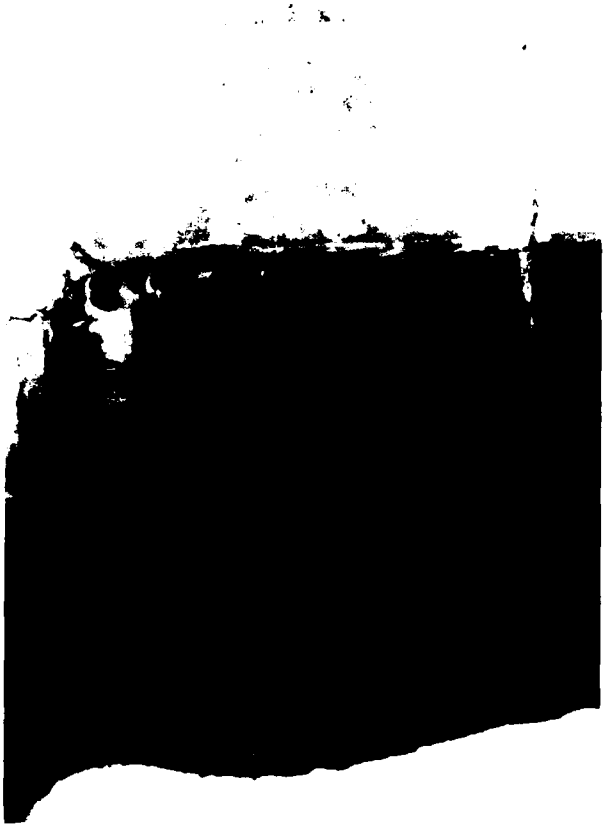


PHOTO NO. 9
Crack in spillway training wall, right (west) side, approximately 100' downstream from crest.

PHOTO NO. 10
Looking downstream along spillway channel from end of training wall.

PHOTO NO. 11
View along second berm, standing water, slight flow may be surface runoff, rule extended three feet.

PHOTO NO. 12
Looking downstream along outlet channel.

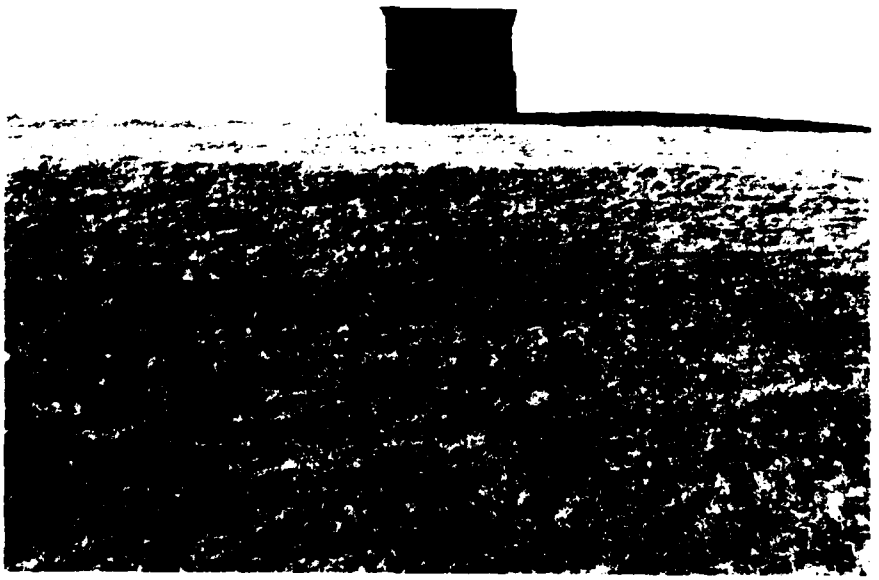


PHOTO NO. 13 - Looking upstream at downstream slope from right (west) edge of outlet training wall.

PHOTO NO. 14
Looking upstream along 4" diameter underground drain outlet from 2' diameter drainage manhole.

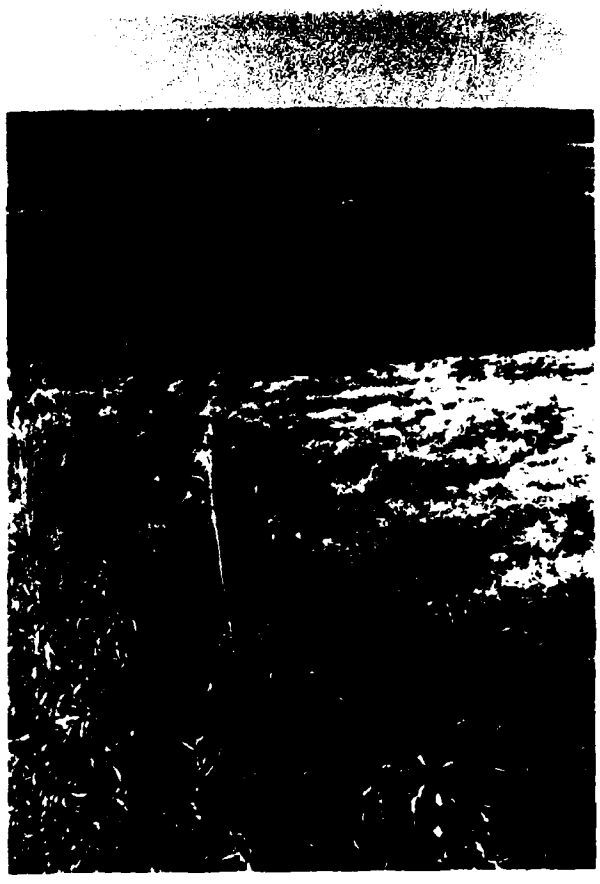


PHOTO NO. 15 - 6" diameter discharge pipe in drainage manhole, depth of water 4'9" below manhole cover, right (west) manhole.

PHOTO NO. 16
Drainage manhole at downstream toe looking toward left (east) abutment.

PHOTO NO. 17 - 6" diameter discharge pipe in east drainage manhole, water depth 10' 6".

PHOTO NO. 18 - Hole downstream of toe, due to settling of soil around large boulder placed during construction of dam. Rule extended 3 feet, location 50' east of diversion outlet.

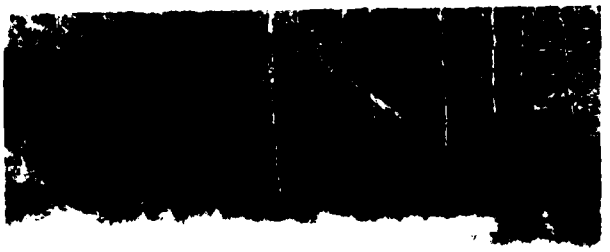


PHOTO NO. 19
Large holes, up to 2 feet deep, downstream of dam 200 feet left (east) of diversion outlet. Rule extended 3 feet.

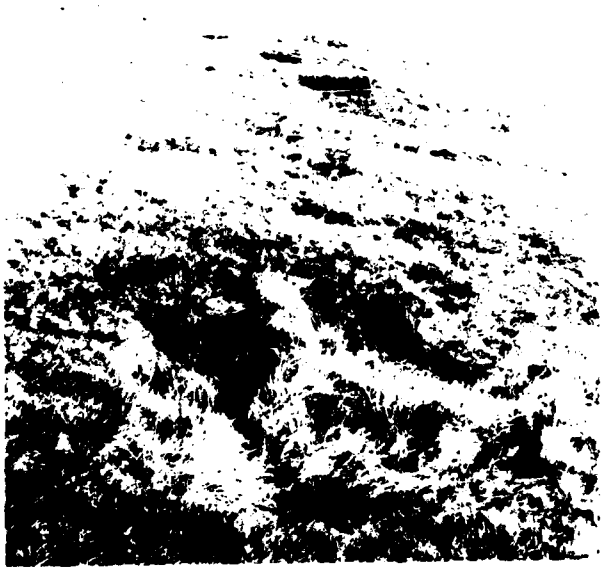


PHOTO NO. 20 - Looking downstream at toe from diversion outlet. Holes in center are those shown in Photo No. 18.

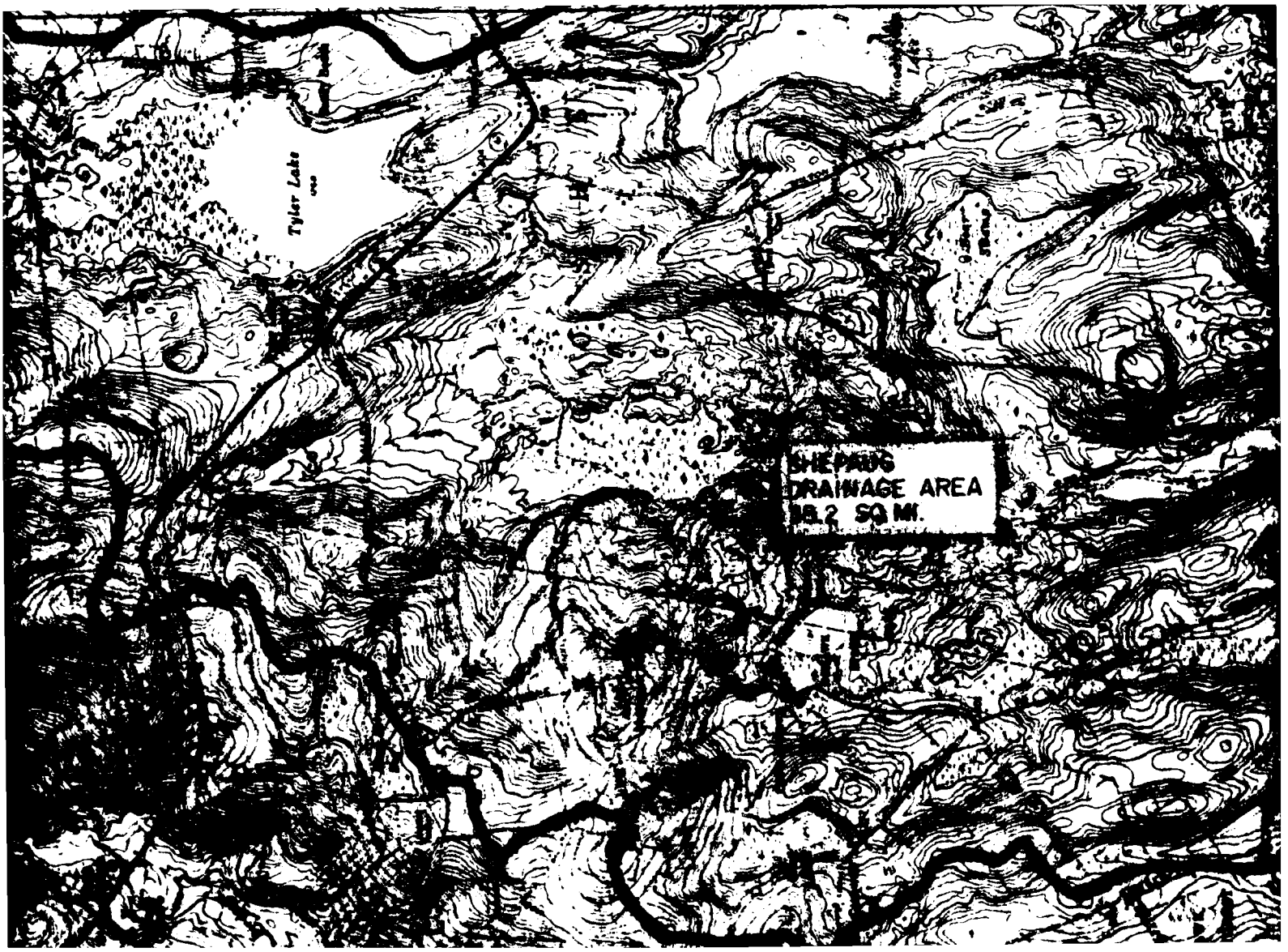
PHOTO NO. 21 - Looking along downstream slope from crest of dam 50 feet left (east) of tower.

PHOTO NO. 22 - Looking toward left (east) abutment from upstream crest 75 feet left (east) of tower.

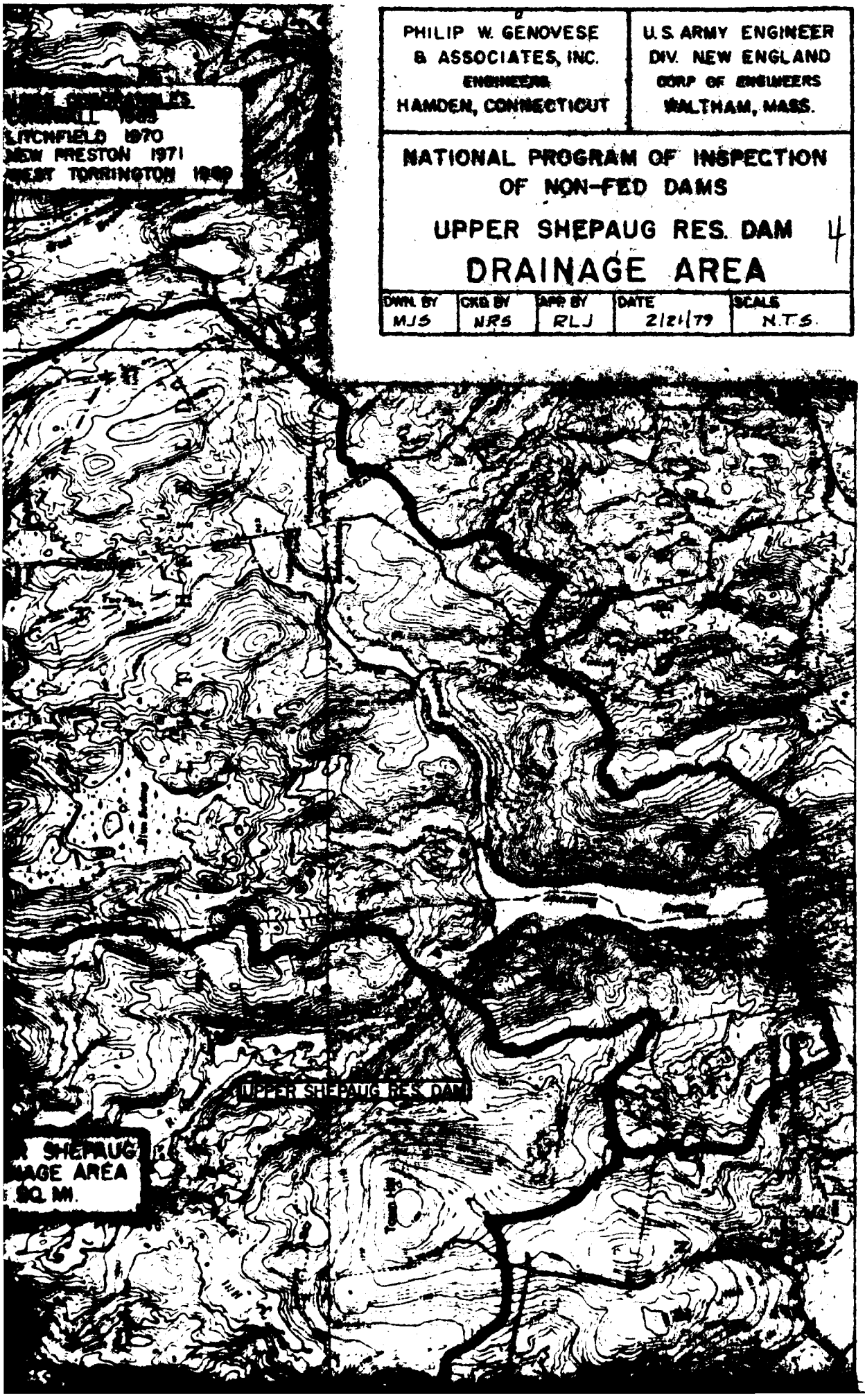
APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS


Tyler Lake


Tyler Lake
SHEPAUG
DRAINAGE AREA
38.2 SQ MI.


UPPE
DR
DWN. BY
MJS



PHILIP W. GENOVESE & ASSOCIATES, INC. ENGINEERS HAMDEN, CONNECTICUT	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORP OF ENGINEERS WALTHAM, MASS.

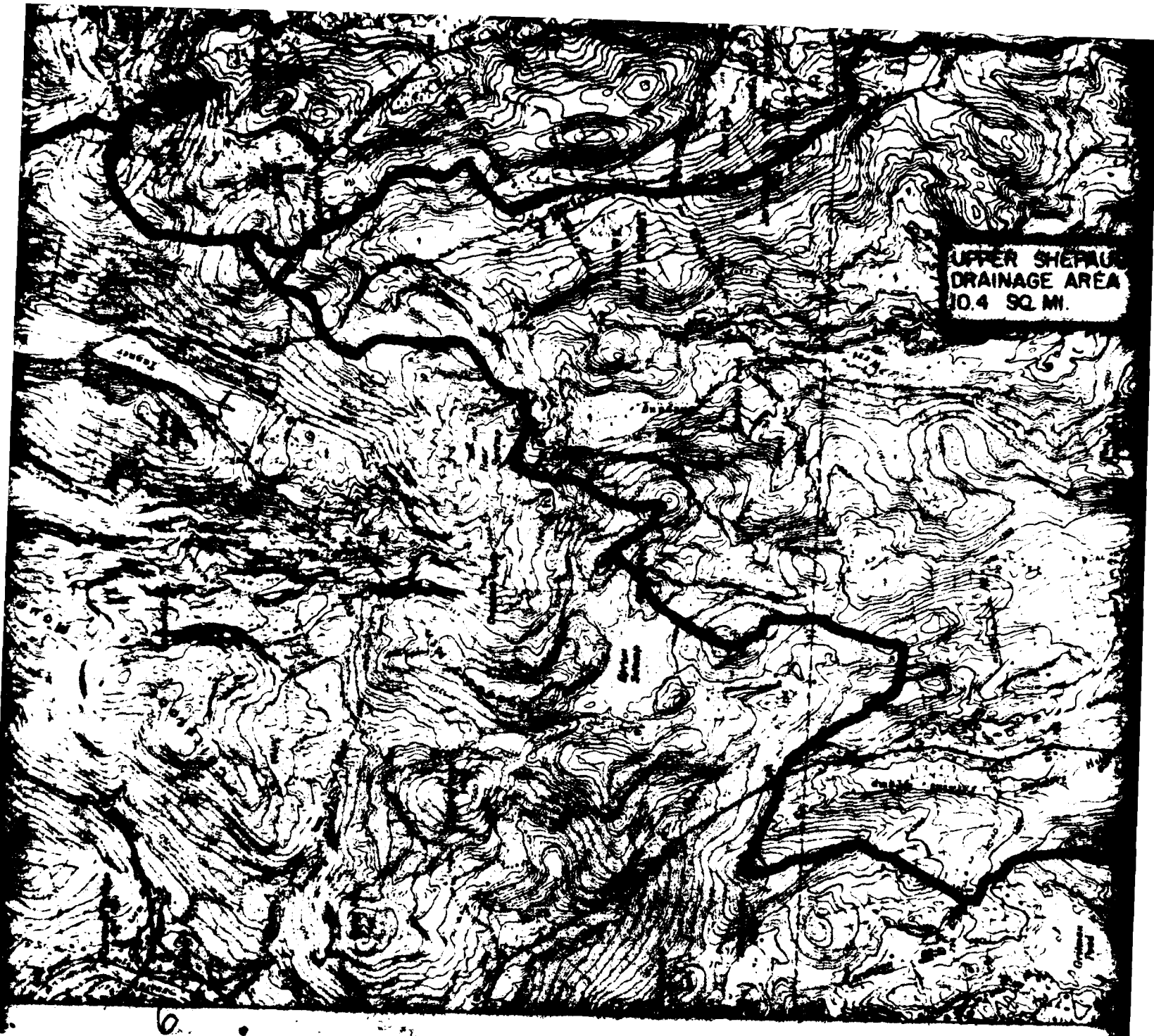
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

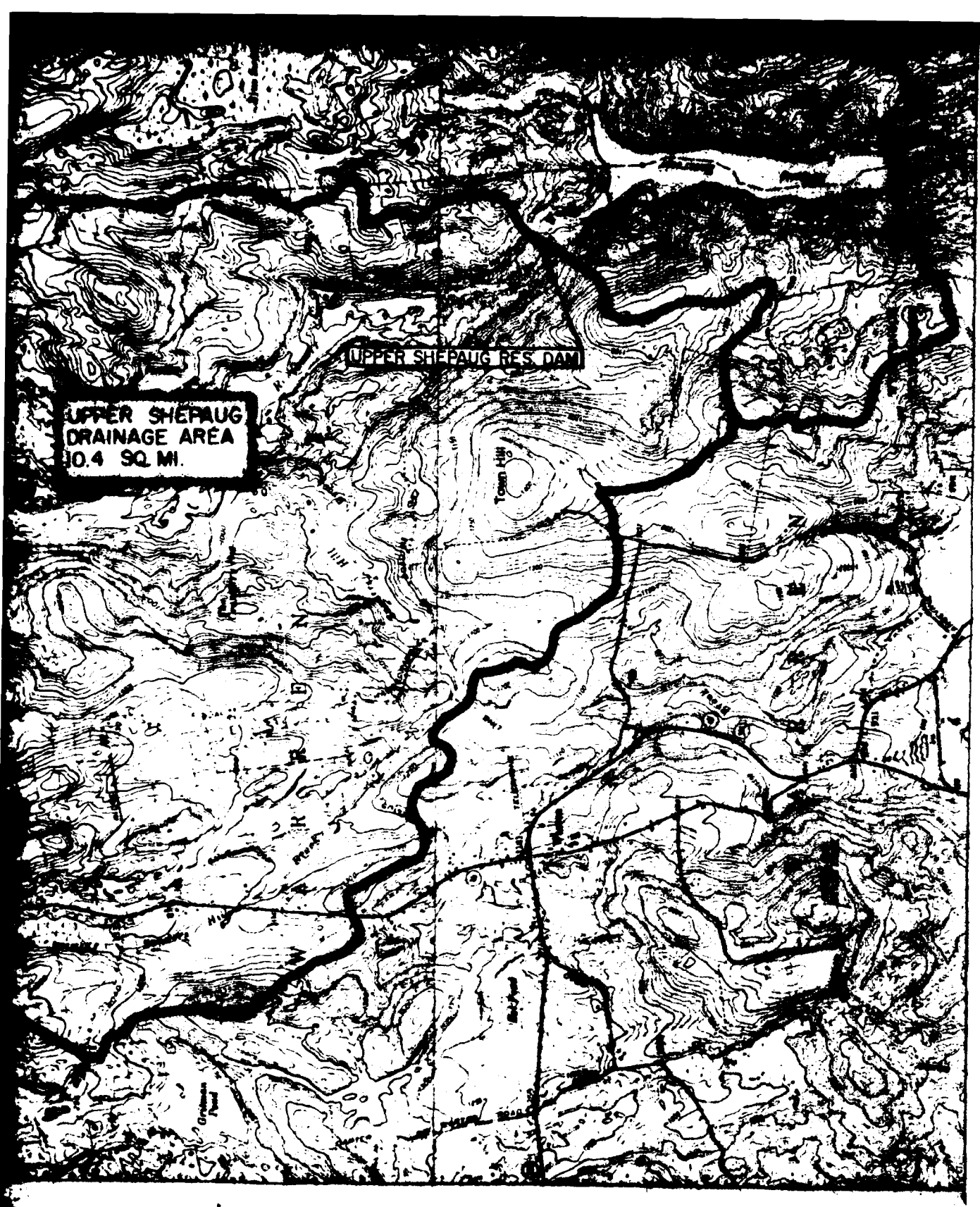
UPPER SHEPAUG RES. DAM 4

DRAINAGE AREA

DWN. BY	CKD BY	APP. BY	DATE	SCALE
MJS	NRS	RLJ	2/21/79	N.T.S.


Brook
Brook
Brook


UPPER SHEFFIELD
DRAINAGE AREA
10.4 SQ. MI.


UPPER SHEPAUG RES. DAM
UPPER SHEPAUG
DRAINAGE AREA
10.4 SQ. MI.

Name	Upper Shepaug Reservoir
Location	Warren, CT.
Drainage Area	6656 Acres / 10.4 sq-miles
Spillway Crest	Elev 910.0
Top of Dam	Elev 922.0
Dam Height	87 Feet
Size & Hazard	Intermediate - High
Test Flood (TF)	PMF
TF Runoff	19"
TF Peak Discharge	18,720 cfs
TF Volume	10,538 Ac-Ft
Spillway Storage	4,650 Ac-Ft (No Freeboard)
Q_{peak} Out Flow	11,900 cfs
Stage @ Q_{peak} Outflow	Elev 920.1
Storage @ Peak Outflow	3880 Ac-Ft
Spillway Type	Concrete Ogee Shaped with Side Channel Spillway
Breaching Discharge	237,572 cfs

Upper Shepaug

Feb 1979
By D T Ballou

Evaluate the "Size" & "Hazard" classification of the dam in order to arrive @ the magnitude of the spillway design storm (SDF) (test storm)

Use tables # 1, 2 & 3 of the DOA · OCE. guidelines dated Nov. 1976

Size classification

(a) Top of Dam elev = 922.0
downstream low point elev = 835.0
∴ Height of Dam = 87.0 feet

(b) Reservoir area @ flow line = 348 acres (elev 910.0)
∴ Estimated volume below flow line
= ⅓ bh = ⅓ × 348 × 87′ = 10,092 Ac-Ft.

Volume between flowline & top of Dam is 4650 Ac-Ft for a total maximum storage capacity of 14,742 Ac-Ft

Hence, from table # 1 the size classification is Intermediate

Hazard Potential

While there appears to be no habitation of any form immediately downstream of the dam, it should be noted that Shepaug Dam Reservoir is immediately downstream by about 1500 feet. The reservoir itself being a water supply for the City of Waterbury and

approximately 6000 feet in length. Downstream of Shepaug Dam by 6000 feet is the town of Woodville. The valley that lies between Woodville & Shepaug Dam has approximately 12 → 15 houses with three houses quite low & close to the Shepaug River. Because of these relationships it is felt that a hazard classification of High should be placed on Upper Shepaug Dam

Spillway Design Storm (SDF) (Test Storm)

From table #3 of the O.C.E. guidelines entering with a size classification of intermediate and a hazard potential of High a SDF of PMF is recommended.

The calculations were done for both the PMF & ½ PMF, however the PMF is still the selected "Test Flood" (SDF)

Using data furnished by the Corp N.E.D.; a drainage area of 10.41 sq. miles, and a D.A. terrain that would appear to fall somewhere between "Rolling" & Mountainous the SDF are as follows:

rolling = 1640 csm
Mountainous = 1970 csm

Feb 1979
By: D.T. Balbu

Select a csm value of 1800, which is about half-way between rolling & mountainous
∴ PMF = 1800 cfs/mi² x 10.4 mi² = 18720 cfs

and ½ PMF = 9360 cfs

Find Runoff volume in ½ PMF & PMF

Note:
The PMF has 19" of R.O.
∴ ½ PMF has 9½" of R.O.

D.A. = 10.4 sq-miles

V_{PMF} = (53.33 Ac-Ft/in R.O./mi²)(10.4)(19) = 10,538 Ac-Ft

$V_{½PMF}$ = 5,269 Ac-Ft

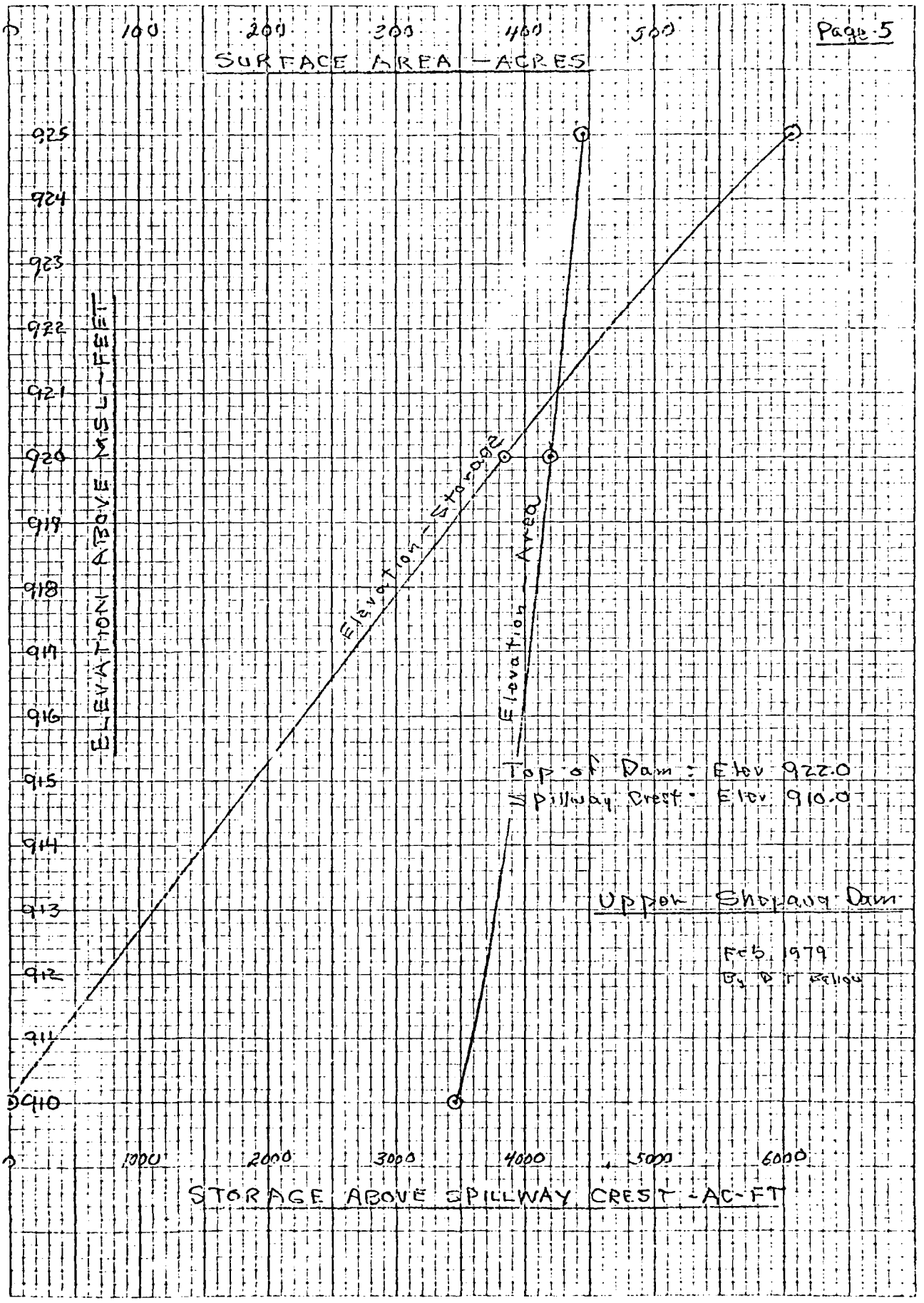
Note that there is 4,650 Ac-Ft of available storage between the spillway crest & the top of dam (see graph next page)

Check hydrograph time of PMF:

$$T = S \times 24.2 \times \frac{1}{Q}$$

$$= 10,538 \times 24.2 \times \frac{1}{18720} = 13.6 \text{ hours}$$

Note: ½ PMF would have same time.


SURFACE AREA - ACRES
100
200
300
400
500
ELEVATION ABOVE MSL - FEET
925
924
923
922
921
920
919
918
917
916
915
914
913
912
911
910
Elevation - Area
Elevation - Storage
Top of Dam - Elev 922.0
Spillway Crest - Elev 910.0
Upper Shopaug Dam
Feb 1979
1000
2000
3000
4000
5000
6000
STORAGE ABOVE SPILLWAY CREST - AC-FT

Feb 1979
By DT Ballou

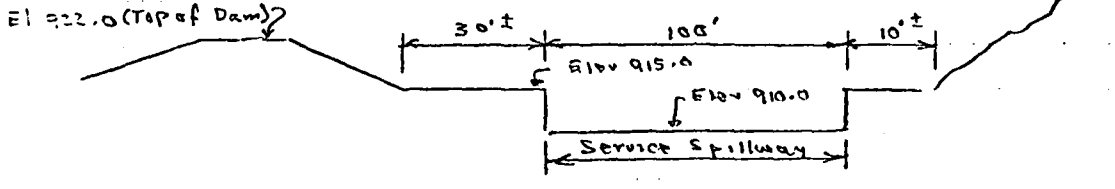
Work up Rating Curve for Service spillway

The spillway is 100' long, ogee shaped, and training walls that extend to a height of 5' above the spwy crest; evaluate this section and the overflow that occurs above this point. (See sketch Below)

$Q_w = C L H^{3/2}$ where $C = 3.9$ $\Sigma L = 100'$

$Q_{overflow\ section} = C L H^{3/2}$ where $C = 2.7$ $\Sigma L = 40'$

Elev MSL	Head ft	$H^{3/2}$	Q_w cfs	H overflow section	Q_o overflow section cfs	Q_{Total} cfs
910	0	0	0			0
911	1	1	390			390
912	2	2.83	1103			1103
913	3	5.20	2026			2026
914	4	8	3120			3120
915	5	11.18	4360	—	—	4360
916	6	14.70	5732	1	108	5840
917	7	18.52	7223	2	306	7529
918	8	22.63	8825	3	562	9387
919	9	27	10,530	4	864	11,394
920	10	31.62	12,333	5	1207	13,540
922	12	41.57	16,212	7	2000	18,212

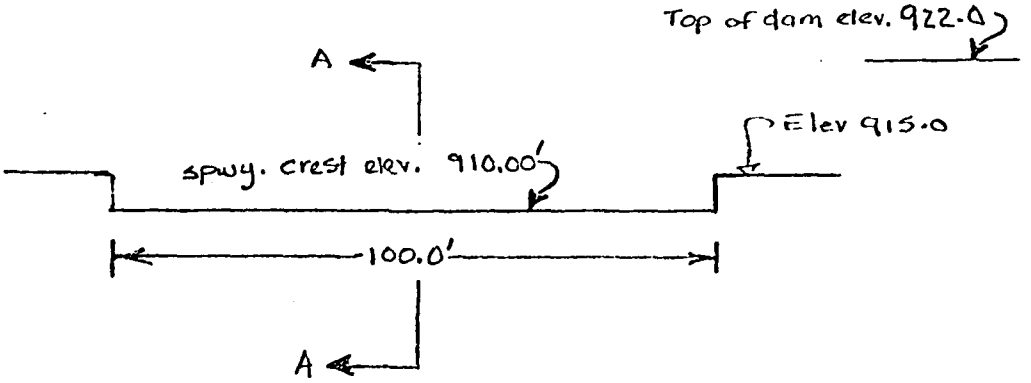


Section Looking Downstream

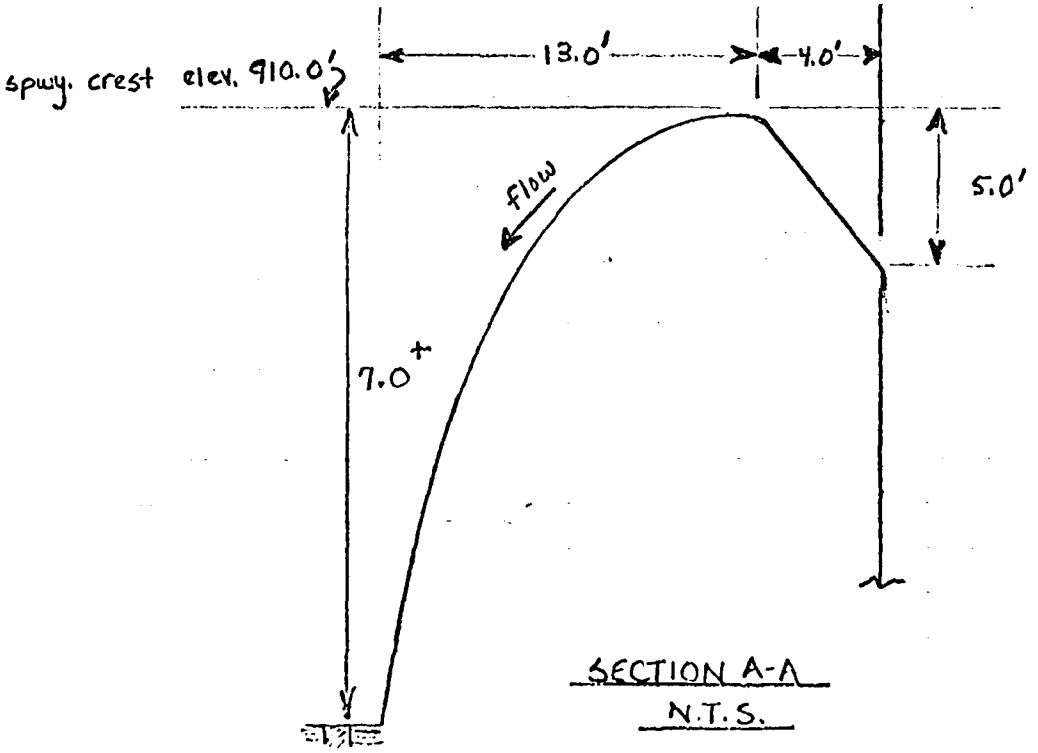
Jan. 1979

UPPER SHEPAUG RESERVOIR, Warren, Conn.

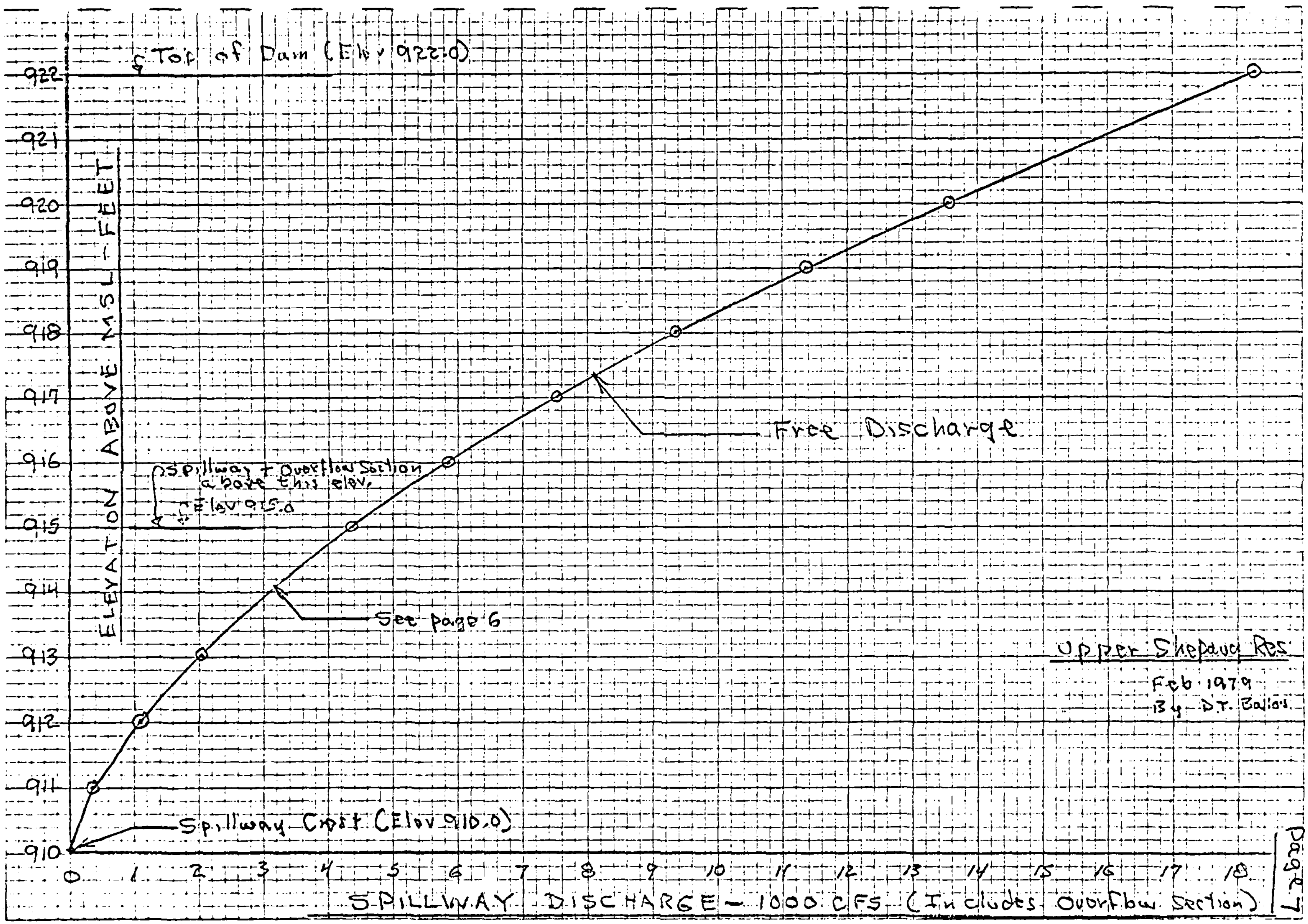
SERVICE SPILLWAY



ELEVATION VIEW
LOOKING UPSTREAM
N.T.S.



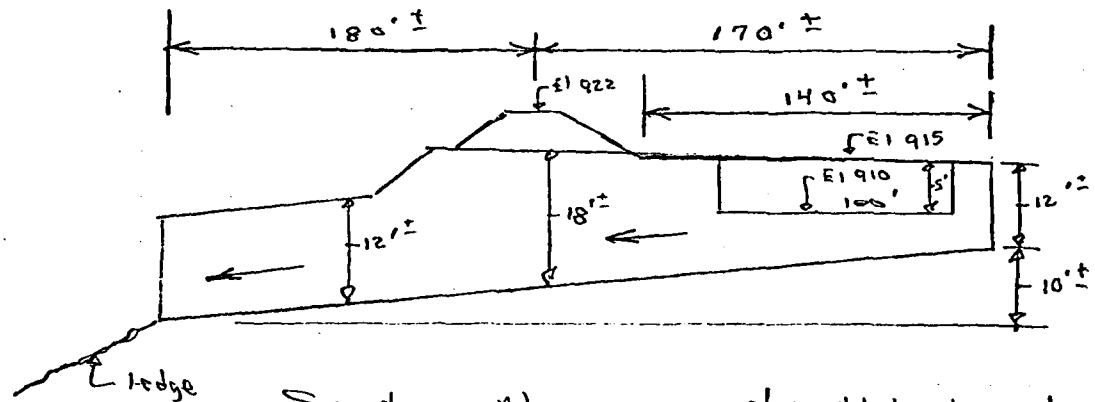
SECTION A-A
N.T.S.


℄ Top of Dam (Elev 922.0)
922
921
920
919
918
917
916
915
914
913
912
911
910
ELEVATION ABOVE MSL - FEET
Spillway + Overflow Section above this elev.
℄ Elev 915.0
Free Discharge
See page 6
Spillway Crest (Elev 910.0)
Upper Shepaug Res
Feb 1979
By D.T. Balios
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
SPILLWAY DISCHARGE - 1000 CFS (Includes Overflow Section)

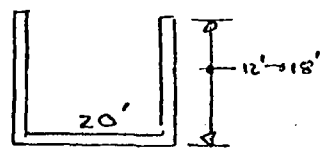
Side Channel Discharge

Feb 1979
By: D.T. Ballou

Evaluate existing concrete channel that is the outlet channel downstream of the service spillway. (This may be a control)



Section Along Spwy & Outlet Channel
Looking West



Channel Section

use manning equation

$V = (1.49/n) R^{2/3} S^{1/2}$ where $n = 0.013$, $S = 10/350 = 0.02857$

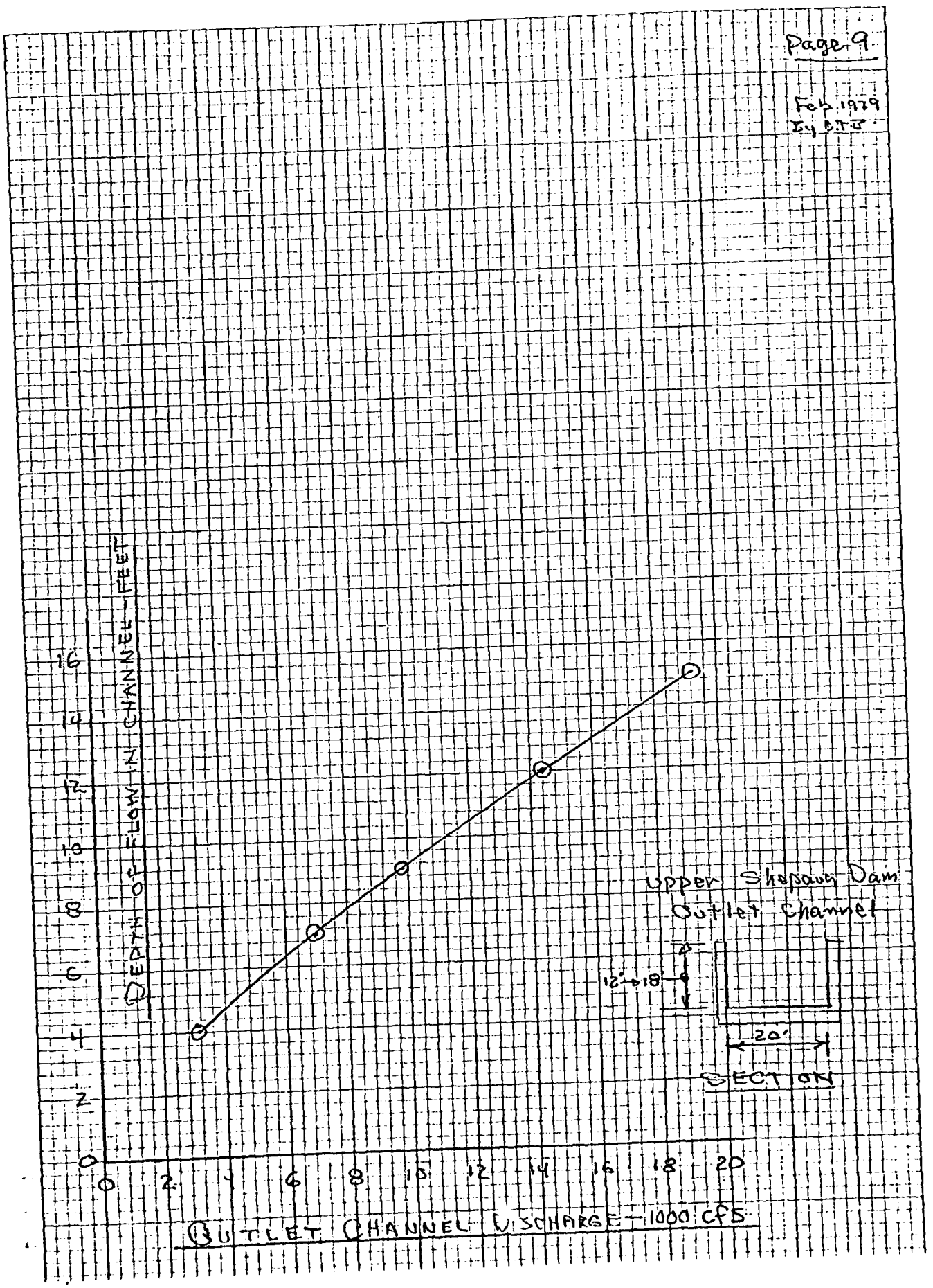
$Q = AV$ $\qquad S^{1/2} = 0.1690$

$\therefore Q = A \frac{1.49}{n} \times R^{2/3} S^{1/2} = AR^{2/3}(19.37)$

Depth ft	Area ft²	R	$R^{2/3}$	Q cfs	
10	200	5	2.92	11,315	See graph next page
12	240	5.45	3.10	14,403	
14	280	5.83	3.24	17,573	
15	300	6.0	3.30	19,185	
9	180	4.74	2.82	9,833	
* 7	140	4.12	2.57	6,966	

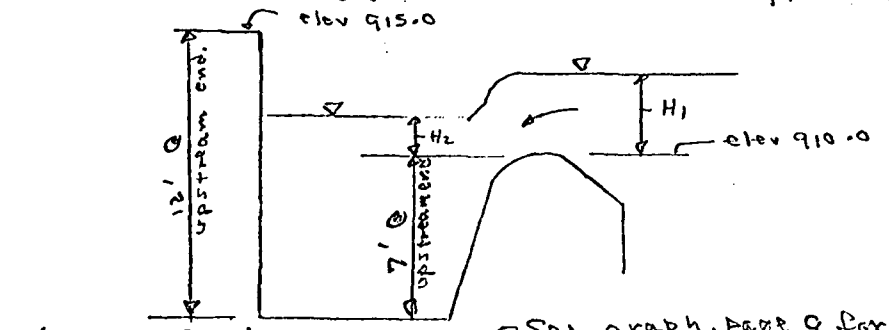
* Max depth in channel before possibility of submerging weir!

Feb. 1979
By B.T.S.



Feb. 1979
By DT Ballou

Evaluate possibility of spillway becoming submerged - USA Kings Handbook, 5th edition, page 5-18, figure 5-5, curve #2. While Fig 5-5 is not applicable to broadcrested weirs it will serve as an indication of flow relationships.



Vertical Section thru spwy

See graph, page 9 for depth after adding flows from col. ① & ②

Elev	H_1	① Q_1 Spillway (Free Discharge) (cfs)	② D Channel Depth ①+⑥ (ft)	③ H_2 (ft)	④ H_2/H_1 Fig 5-5	⑤ Q/Q_1 Fig 5-5	⑥ Q_3 overbank section cfs	⑦ Q_{TOTAL} cfs ⑤x①+⑥
915	5	4360	5	-2	—	—	—	4,360
917	7	7223	7.5	+0.5	0.07	1.0	306	7,529
918	8	8825	8.8	1.8	0.23	0.95	562	8,946
919	9	10,530	10.1	3.1	0.34	0.91	864	10,446
920	10	12,333	11.5	4.5	0.45	0.86	1207	11,813
922	12	16,212	14.4	7.4	0.62	0.78	*2000	14,645

Comments

*1. The 2000 cfs was kept separate as the final Q of 14,645 cfs is ≅ to 14,403 cfs as found on page 7 indicating the flow the channel would take with a 12' depth, which would not overtop the channel training walls.

2. The above approach for arriving @ Q_{TOTAL}, Column ⑦ is felt to be rational in the sense that it takes pertinent factors into account.

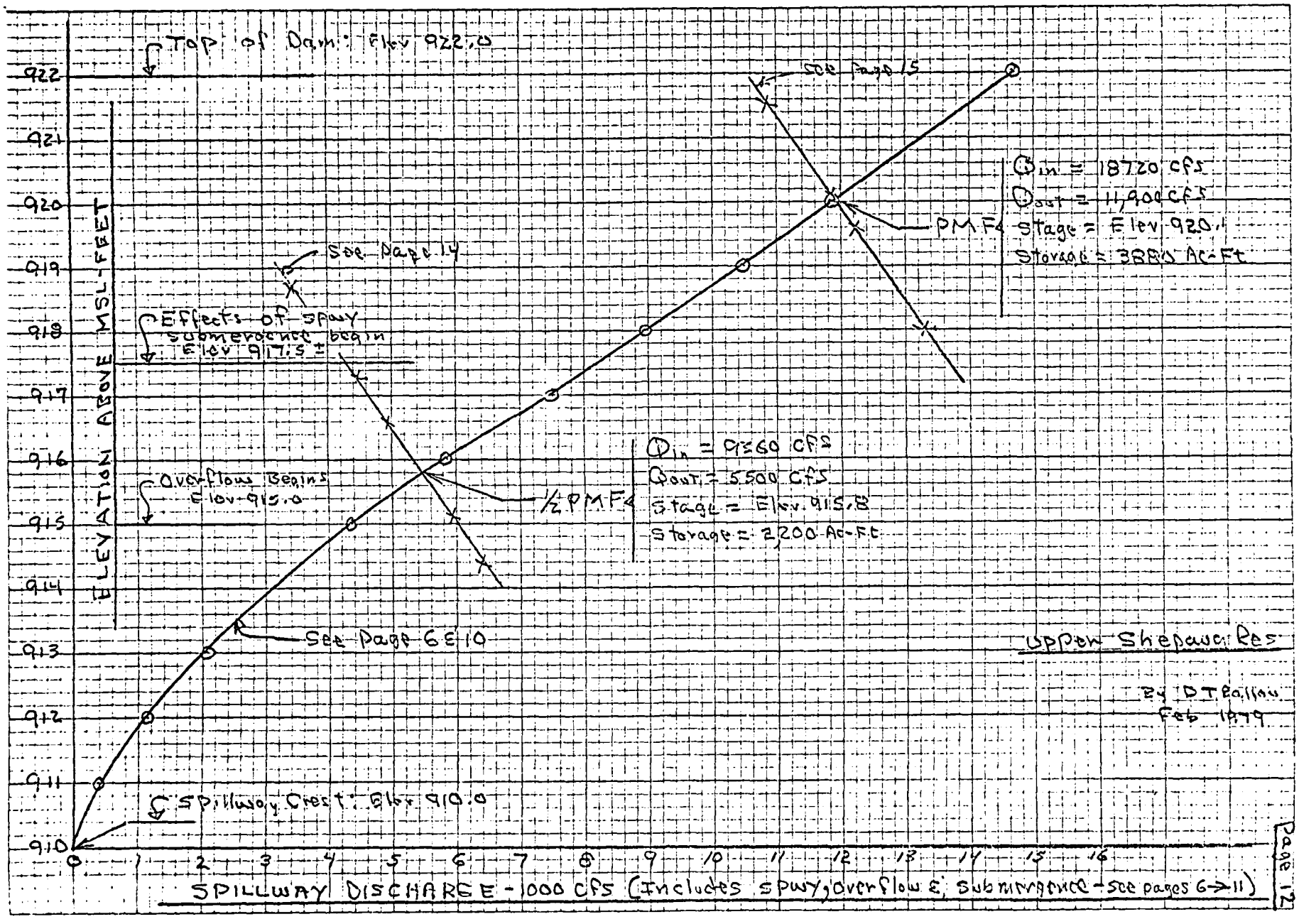
Feb 1979
By D.T. Ballou

Comments continued

3. The 7' depth in the channel that was utilized before submergence took place exists @ the upstream end only. The channel is ≅ 2.8' deeper, due to slope, @ the south end of the spillway. This method of appraisal will work in a conservative direction as regards outlet works discharge capability, i.e. The outlet works will probably pass a greater flow than indicated. It is felt that further refinement would be inappropriate.

At this point we are ready to graph the data of page 10 and commence the shortcut routing procedure to determine capability of structure to pass a storm equivalent to the ½ PMF & PMF.

Data to be utilized from page 10 is Elev versus column (7). Flow below elev 915.0 may be obtained from page 6.



Upper Shepaug Res

By DT Ballou
Feb 1979

Feb 1979
By D.T. Ballou

Routing of ½ PMF, = 9360 cfs

Check maximum storage by short-cut routing method for ½ PMF as the minimum criteria to satisfy the SDF. Then determine what % of the PMF is passable without overtopping the structure. (Dam).

$Q_{peak\ of\ \frac{1}{2}PMF} = 9360$ cfs

Select surcharge storage associated with a flow of ½ PMF. This is a beginning point utilized in order to select several lower & higher points to use in routing.

For $Q_{p_1} = 9360$ cfs the stage-discharge graph (page 12) indicates elev 918.3±

For elev. 918.3 the stage-storage curve on page 5 reflects 3150 AC-Ft. This would be:

$$\left(\frac{3150\ \text{AC-Ft}}{6656\ \text{Acres}}\right)\left(12\ \frac{\text{in}}{\text{Ft}}\right) = 5.68\ \text{inches of R.O.} = \text{Stor}_i$$

∴ Select R.O. of 4½", 5", 5.68" & 6"

$$Q_{p_i} = Q_{p_1}\left(1 - \frac{\text{Stor}_i}{9.5''}\right) = 9360\left(1 - \frac{\text{Stor}_i}{9.5''}\right)$$

(Q_{p_1}: SDF; 9.5": R.O. for SDF; Stor_i: R.O.)

Feb 1979
By D.T Ballou

Continue Routing of ½ PMF

① Stor(i) inches	② $\left(1-\frac{Stor(i)}{9.5}\right)$	③ Stor(i)' Ac-Ft (① x Area)	④ Qpi cfs (③ x 9360)	⑤ Elev. from page 5 for Col ③
6.0	0.368	3,328	3444	918.7
5.68	0.402	3,150	3763	918.3
5.0	0.474	2,773	4437	917.3
4.5	0.526	2,496	4923	916.6
3.5	0.632	1941	5916	915.1
3.0	0.684	1664	6402	914.4

Note: Columns ④ & ⑤ are plotted on page 12 to indicate maximum reservoir level & spwy discharge for this routing of ½ PMF; = 9360 cfs.

Maximum Reservoir Elev = 915.8
Maximum Discharge ≅ 5,500 cfs
Maximum Storage = 3,200 Ac-Ft (See page 5)

Note that Top of Dam = elev 922.0

Try Routing the PMF & see where it falls

Feb 1979
D T Ballou

Routing of PMF, = 18720 cfs = Q_{P_1}

For a beginning point select surcharge storage associated with 60% of PMF, which = 11,232 cfs

For Q_i = 11,232 cfs the stage - Discharge curve (page 12) indicates elev 919.6

For elev 919.6 the stage - storage curve, (page 5) indicates 3,670 Ac-ft.

and: $\frac{3670 \text{ Ac-Ft}}{6656 \text{ ACRES}} \times 12 \text{ "/ft} = 6.62\text{"}$ of RO. = Stor(i)

$$Q_{Pi} = Q_{P_1}\left(1 - \frac{\text{Stor}(i)}{19"}\right) = 18{,}720\left(1 - \frac{\text{Stor}(i)}{19"}\right)$$

Σ RO - (inches)

L RO - for SDF

① Stor(i) inches	② $\left(1 - \frac{\text{Stor}(i)}{19"}\right)$	③ Stor(i) Ac-Ft ① x Area	④ Q_{Pi} cfs	⑤ Elev. From page 5 for col ③
8.00	0.579	4437	10839	921.5
7.00	0.632	3883	11,831	920.1
6.62	0.652	3672	12,205	919.6
5.50	0.711	3051	13,301	918.0

Columns ④ & ⑤ are plotted on page 12 & indicate:

1. Max Reservoir Level = Elev 920.1
2. Max Discharge = 11,900 cfs
3. Max Storage = 3880 Ac-Ft (on Pg 5)

April 1979
By: D.T. Ballou

Breaching Analysis & Comments

Test Flood Stage = Elev 920.1
Dam Low point = Elev 835.0
$\Delta = 85.1$

Crest length $\cong$ 1000'
width halfway up $\cong$ 600'
$W_b \cong 30\% \times 600 = 180'$

$$Q_{p_1} = \frac{8}{27} \times 180 \times \sqrt{g} \, (85.1)^{3/2}$$

$$= 237,572 \text{ cfs}$$

Total Storage to Top of Dam $\cong$ 14,700 Ac-Ft

A downstream routing was not accomplished as there is only about 1500 feet of uninhabited valley that lies between Upper Shepaug Dam and the upstream reaches of Shepaug Reservoir, both important water supply facilities for the Waterbury area. The Shepaug dam was breached and downstream water profile to the town of Woodville was established.

Feb 1979
By D.T. Balbu

Comments

The size & hazard classification indicated a SDF of the PMF. both ½ PMF & the PMF were evaluated and the results may be viewed on page 12.

There appears not to be any problems associated with overtopping. as the ½ PMF left a freeboard of 6.2 feet and the PMF left a freeboard of 1.9 feet.

None of the conduits were utilized in routing the "Test Flood"

May 1979

Note:
Relative storage capabilities of Upper Shepaug & Shepaug.

1. Upper Shepaug to top of dam has an approximate "total" storage ≅ 14,700 Ac-ft.
2. Shepaug to top of Dam ≅ 3000 Ac-ft
   " " spwy crest ≅ 2000 Ac-ft
3. With water level in Shepaug @ the spwy crest elev of @19.0 & Upper Shepaug releasing its total storage of 14,700 Ac-ft the surcharge @ Shepaug would be @ elev @96.0 which = 77 feet (seventy-seven feet) above the Shepaug Spwy crest. This is based on a volumetric comparison only. (See next page)

Comments Continued

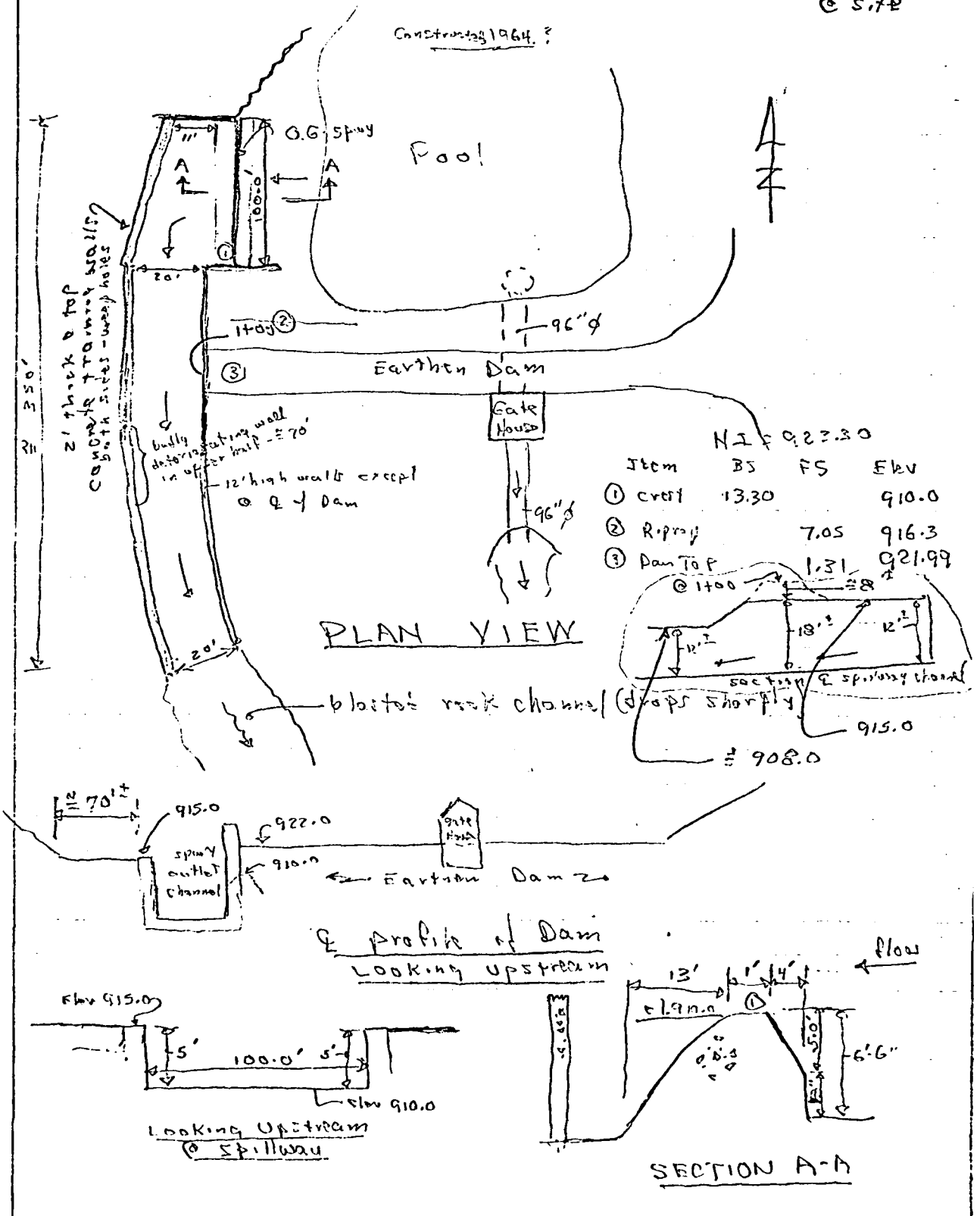
A more realistic approach utilized the breaching Q of 237,572 cfs (see pg 16) & determine this point on the discharge rating curve or data for Shepaug Dam. This was done @ a 33.5. head over the spillway Crest @ Shepaug Dam was found to pass the 237,572 cfs.

Therefore instead of 77' @ elev 896 @ Shepaug we would attain 33.5' @ elev 852.5 as the maximum flooding level due to a breaching of Upper Shepaug Dam.

There exists far better delineative methodology on the foregoing discussion under item 3 (this item). However, within the scope of this project it certainly is not warranted.

UPPER SHEPAUG

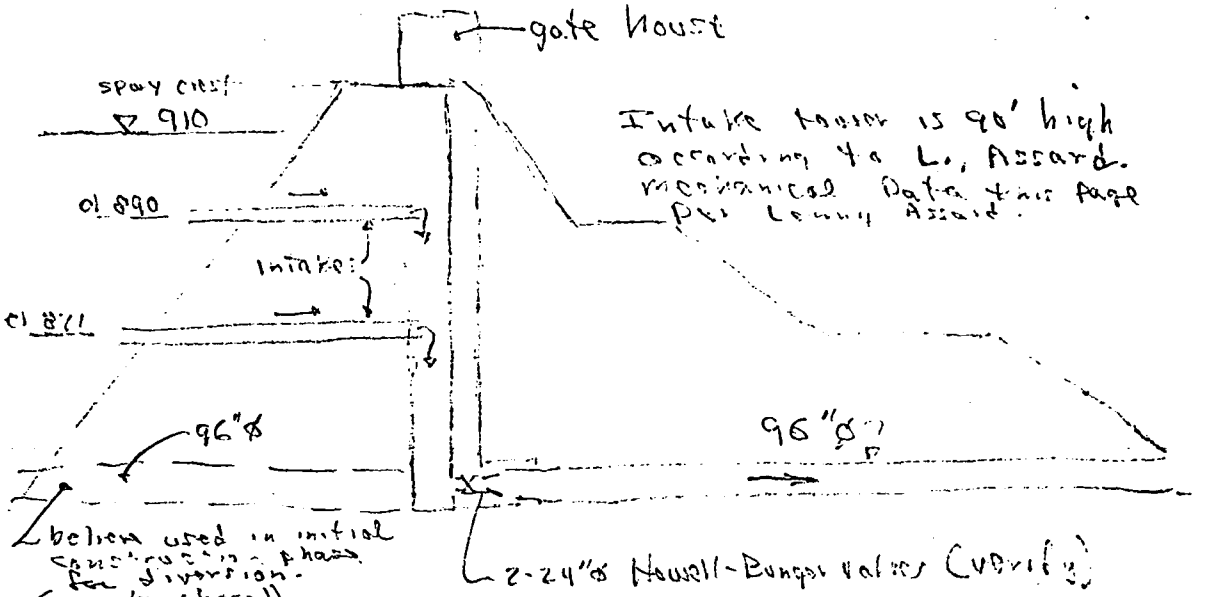
12/6/78
1:05 → 3:40PM
@ site



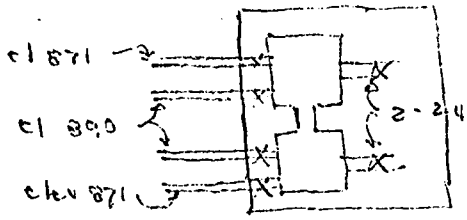
UPPER SHEPAUG

(2)

12/6/78



SECTION THRU DAM & OUTLET WORKS



Intake Tower
PLAN VIEW

Finding Reservoir Level

Item	BS	FS	Elev
	HI = 911.54		
spwy Crest	1.54		910.0
TP #1		14.65	896.89
	HI = 902.53		
TP #1	5.64		896.89
water level in reservoir		13.98	888.55

Top of Dam = 921.99 (see sheet 1)
water level = 888.55
Δ = 33.44'

APPENDIX E

INFORMATION AS CONTAINED IN THE INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	COUNTY	CONGR DIST	STATE	COUNTY	CONGR DIST	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
[illegible]	CT	005	06			UPPER SHEPAUG RESERVOIR DAM	[illegible]	[illegible]	[illegible] MAY 79

POPULAR NAME	NAME OF IMPOUNDMENT
	UPPER SHEPAUG RE[illegible]

REGION BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	DIST FROM DAM (MI)	POPULATION
[illegible] 07	WEST BRANCH SHEPAUG RIVER	[illegible] VILLE	2	100

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT)	HYDRAULIC HEIGHT (FT)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT)	NORMAL (ACRE-FT)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
	19[illegible]	S	87	8[illegible]	13[illegible]	[illegible]	NED	N	N	N	N	[illegible] MAY 79

REMARKS

[illegible] IN TOWN OF [illegible]

D/S HAS	SPILLWAY TYPE	WIDTH (FT)	MAXIMUM DISCHARGE (FT)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	PROPOSED (MW)	NAVIGATION LOCKS
[illegible]	[illegible]	[illegible]	[illegible]				

OWNER	ENGINEERING BY	CONSTRUCTION BY
CITY OF WATERBURY	MALCOLM PIRNIE ENG	

REGULATORY AGENCY

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
[illegible]	[illegible]	[illegible]	CT DEP

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
PHILLIP [illegible] AND ASSOCIATES	[illegible]	[illegible]

REMARKS


DATE
ILME